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the glass industry

CONTENTS FOR SEPTEMBER : 1954

Physical Properties for Glass Control ... 481
The author states that for most glasses quantity-produced in continuous tanks, the purposes of control are best served by physical property testing rather than chemical analysis. Criteria for control and their relation to various physical properties are presented. By Howard R. Lillie.

Type and Design of Refractories for Glass Melting Furnaces ... 485
A paper dealing specifically with refractories for pots, day tanks, refiners and bottoms. By J. A. Johnson.

Silk Screen Printing with Bright Gold ... 486
Materials, equipment and methods for gold application to glass are presented in this brief paper. By R. J. Miller.

Glass Analysis Time Reduced from 1½ Days to 2 Hours ... 487
How Glass Containers, Inc. uses the spectrophotometer in controlling viscosity.

Alkalies and Glass: Allied Industries ... 488
The scope, history, process and methods of quality control of the alkali industry are outlined in this paper. By H. W. Harrington and R. V. Yount.

Lenses — 300 B. C. ... 491
An interesting account of what are believed to be the oldest lenses in the world.

Recent Translations of Russian Papers of Interest to the Glass Industry ... 492
Abstracts of several papers translated from the Russian journal of the glass and ceramic industries.

Inventions and Inventors ... 495
A summary of recently issued patents of interest to the glass industry.

Research Digest ... 501
"Assessment of the Efficiency of Glass Tank Furnaces", which originally appeared in the June 1954 issue of the *Proceedings of the International Commission on Glass.*

Current Statistical Position of Glass ... 503
Production, shipments and employment in the glass industry during June and July 1954.

New Equipment and Supplies ... 506

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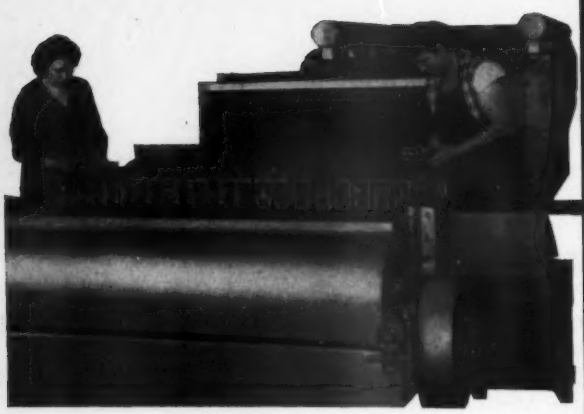

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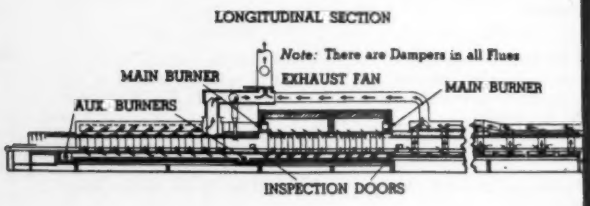

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THE GLASS INDUSTRY

VOLUME 35, NUMBER 9, SEPTEMBER, 1954

PHYSICAL PROPERTIES FOR GLASS CONTROL

By HOWARD R. LILLIE

Corning Glass Works, Corning, New York

The Purpose of Control

Many factors are involved in the control of glass melting operations. Thus it is necessary, in any discussion of control, to define at the outset what phase of this complex subject is being treated. The present purpose of the writer is to consider tests to which the glass, as a material rather than as ware, may be effectively subjected with the object of inferring from the results what corrective measures might assist in maintaining the glass at nominal properties or in gradually returning it to such properties. We shall not be concerned with what these corrective measures are, since they are obviously different for each type of glass and may also vary with the degree of correction indicated by the tests. Also, we are not directly concerned with the use of the tests as a means of determining acceptance, as here again the tolerances may differ broadly with the type of ware being produced and with the detailed requirements of that ware.

It will be assumed in this discussion that if the glass maintains certain properties, it is indeed constant with regard to essential requirements. That such an assumption cannot always be made will become apparent in the discussion, but this circumstance simply indicates that additional tests are sometimes necessary. On the whole, the primary controls are the same for most high-production glasses and special or secondary controls may be regarded as supplementary to the primary ones and in the nature of acceptance tests.

Since the purpose of control is to maintain within limits a uniformity of product, it is of interest to consider the two sources from which specifications and tolerances generally arise.

(1) *Glasshouse Operations.* In high-speed machine forming operations, all conditions are so adjusted as to bring the entire sequence to maximum efficiency. Since a zero level of rejection often indicates that a speed-up is possible, it may imply less than maximum efficiency. Thus, the criterion of efficiency may be in terms of the *number* of good pieces per feeder hour, rather than what *fraction* of the production is good. Whenever this is the case, it follows that each individual adjustment is so critical that any minor change in glass properties might result in excessive selection loss. It becomes essential, then, to control the glass as closely as possible and, in any event, to avoid sudden changes of such a nature that normal trimming of machine adjustments cannot keep pace with the fluctuations of the glass.

(2) *The Customer's Operations.* The major part of all glass sold is for applications in which the customer is concerned solely with the physical character of the ware and cares little about the properties of the glass. This can even be said about glasses sold on the basis of their color, their chemical durability or their thermal endurance, in that these properties are attained by a proper choice of composition and generally will not vary broadly enough to create a day-to-day control problem unless for some reason the glass barely meets the requirement.

An intermediate situation exists in applications in which the glass is sold on the basis of closely controlled properties. Examples of this are optical glasses in which the refractive index may be given a tolerance as small as 10×10^{-5} and the index homogeneity as little as 1×10^{-5}, and glasses for electrical applications where minimum resistivity is required. In such cases, where it is known that minor contaminations may cause an appreciable variation in the pertinent property, special control measures outside the main scope of this discussion are required.

As an example of extreme interest on the part of the customer in the properties of the glass, one can cite those applications where the glass is refabricated. This includes machine manufacture of radio tubes and lamps and other articles involving reshaping, sealing to glass or metal and reannealing. In these instances, the uniformity of product and of machine efficiency is closely coupled with the same properties generally recognized as important by the glassmaker. Indeed, it may be said that in many ways

A paper based on the author's talk presented before the Fourteenth Conference on Glass Problems, University of Illinois, Urbana, Illinois.

the problems are identical with those encountered in the glasshouse.

Bearing in mind the reasons outlined above for controlling the glass, control criteria can be considered and the various properties and methods which might be employed can be evaluated.

Criteria for Good Control Measures

Any suitable control system must, in the ideal situation, meet the following requirements:

(1) The tests must be relatively simple, not only in the interest of cost but to encourage adequate testing.

(2) The tests must be meaningful, either in terms of the specifications imposed by the customer, or in terms of properties known to directly influence the glassmaker's operations, or at least to indirectly indicate fluctuations which are known to have such an influence. Assuming that constancy of composition is the primary aim, any test must be such that it indicates changes in composition of the sort that might be expected to occur.

(3) The tests must have sufficient reliability and sensitivity to permit observation of trends that are well within the limits of acceptability. For the present purpose, acceptability may be interpreted either as related to the customer's requirement or as related to variations known to cause trouble in the glassmaker's operations. Thus different jobs or different manufacturing methods could require quite different control test sensitivities.

(4) The tests must be chosen to take into account the importance of the time element. In other words, even though the results may be of negative value during periods of steady operation, it must be possible to obtain data quickly when the need arises due to an upset in operation.

(5) The entire control procedure, consisting of the tests and the method of employing data, should be geared in such a way as to keep the responsible person continually informed, but not in a state of alarm or confusion. With frequent tests of sufficient sensitivity and minimum lag, he will be able to avoid the premature or ill-advised corrections which can account for many glassmaking difficulties. The correct timing of corrections, based on small but established trends, depends on the size and type of melting unit, but in no case is it wise to correct for every departure from normal.

The Choice of Tests

It may justifiably be said of glass that if the composition is maintained perfectly constant, its properties will of necessity also be constant. However, in view of the complexity of most commercial glass compositions, the ever-present impurities, the time-consuming feature of chemical analysis of glass, the uncertainties of this procedure even at its best, the lack of reliable correlation between minor constituents and properties and the ultimate fact that interest in glass largely revolves around its physical properties, it may be said that chemical analysis is one of the least effective means for attaining day-to-day control. These difficulties may one day be overcome, but until such time we shall focus our attention on physical tests and think of chemical analyses in terms of what information they may add to the record of a campaign for future reference and guidance.

Among the many physical properties which might be of use in glass control, those found to be most valuable may be placed in five broad classifications: (1) Viscosity, (2) Expansion, (3) Density, (4) Electrical Properties, (5) Optical Properties. Each of these has a place in some part of the control problem.

(1) *Viscosity*. From the standpoint of glass melting, forming and annealing, the viscosity-temperature relation is the most important property of the material. This is not meant to imply that the process involved in converting the charge to a suitably homogeneous molten glass is simply a physical process, but that in this complex step the viscosity is an extremely important characteristic which materially affects the time required for certain phenomena to take place, the nature of flow and the important matter of the relation between the temperatures used and the liquidus temperature. Once the glass reaches the feeder, the gob control, as well as the mold temperatures, forming pressures, dwell time, take-out time, annealing schedule etc., become substantially dependent upon the viscosity-temperature and temperature-time relations. Thus, any glasshouse which concerns itself with the development of new glasses or the employment of a broad variety of compositions should not be without means of measuring viscosities. How comprehensive such measurements should be depends on the nature of that company's operations.

There are four recognized tests under the general heading of viscosity. These tests, as well as the question of which are control tests, will be discussed below.

(a) *High Temperature Viscosity*. The viscosity-temperature curve is determined by well-established techniques for which only a few references will suffice in the present connection[1]. Since the viscosity changes quite rapidly with temperature, the main burden of precision rests upon temperature uniformity and measurement. To attain proper conditions of temperature, it has been found necessary to employ a rather large sample and to permit sufficient time in the run. Thus, a minimum of more than one day is generally required for obtaining reliable data.

In addition, it frequently happens that a run cannot be immediately scheduled. The result is that this particular test fails to meet criteria 1, 4 and 5, discussed earlier, although it has the meaningfulness and reliability required by criteria 2 and 3.

It is of interest to note that high-temperature viscosity data can be analyzed mathematically in such a way as to yield excellent comparisons between samples of what is nominally the same glass. When the logarithm of viscosity is expressed as a function of temperature, the relation is hyperbolic, of the form[2]:

$$\log\eta = -A + B/(T\text{-}T_o)$$

The constants A, B and T_o can be determined by the method of least squares and, by recalculation to equal viscosities, the difference in temperature between two glasses can be determined much more accurately than is possible graphically.

(b) *Flow Point*. This is a relatively new test[3] by which the temperature corresponding to a viscosity of 10^5 poises can be determined. A fiber of glass 0.65mm. in diameter is placed in a small helix of platinum wire whose temperature can be quickly brought to a standard high level. The time required for the fiber to suddenly elongate is used to indicate the temperature reached. Al-

though this method meets all the other criteria for a good control test, it must be frankly stated that further development is required to give it the reliability and sensitivity implied in criterion No. 3. When this has been achieved, it will surpass the softening point in usefulness because it applies to a lower viscosity and therefore better indicates the real working properties of the glass.

(c) *Softening Point.* In American parlance, the softening point corresponds to a viscosity of about $10^{7.6}$ poises and is measured by the Littleton[4, 5] method which is so well-known as to require no elaboration here. It is by far the simplest and most effective known control test for most glasses and, when employed along with expansion coefficients and experience, can yield an almost unique indication of the batch correction required to reverse an unwanted property trend. By the frequent use of standard glasses[6], the uncertainty in the softening point test can be kept at 1°C. or less.

The softening point test has come to be widely used in this country and it may safely be said that a mechanized glasshouse without the equivalent of softening point facilities is operating below its maximum possible efficiency.

(d) *Annealing and Strain Points.* These points are the temperatures at which the apparent viscosities are $10^{13.0}$ and $10^{14.5}$ poises, respectively, according to the newly adopted definition and procedure [5, 7]. To the writer's knowledge, the test is seldom or never employed as a day-to-day control, but has its principal usefulness in the study and introduction of new glass compositions. However, as an occasional test, together with softening point and expansion, it can be of great assistance in insuring that proper corrections are being made, since if they are incorrect, the spread between softening and annealing points can become abnormal.

To summarize regarding viscosity as a control property:

(a) *High Temperature Curve:* Too slow as a control but indispensable in developing and establishing new glasses and important for furnishing valuable records on production glasses.

(b) *Flow Point:* Needs further development to make it reliable and sensitive enough to compete with softening point.

(c) *Softening Point:* The best of all viscosity tests for control.

(d) *Annealing and Strain Points:* Not very useful in control, but valuable in furnishing data on new or production glasses.

(2) *Expansion.* There are two kinds of expansion measurements in common use in the glass industry.

(a) *Average Coefficient.* This test consists of subjecting a rod of glass, some 4 inches in length, to two relatively low temperatures and calculating from the observed change in length its average coefficient of expansion. A standard procedure has been developed[5] for this test. The recommended temperatures are O°C. and 300°C. and the means of observing the change in length is the dial indicator. The frame of the dilatometer is usually silica glass for which a suitable correction is applied to the observed expansion.

This test meets all the requirements of a good control procedure. Its only shortcoming is the necessity for annealing the samples to some standard condition to remove the uncertainties imposed by previous thermal history. The annealing operation can usually be accomplished in about 1 hour and the actual test requires about 2 hours. Thus, while softening point measurements can be had, if necessary, within the hour, expansion results take somewhat longer.

With a well-built aparatus and an experienced operator, the average coefficient of expansion between O° and 300°C. can be determined to a precision of less than 3×10^{-8} per °C. The absolute accuracy depends on the standards employed and the means by which the silica glass correction is determined. However, for control purposes this factor frequently becomes relatively unimportant.

As mentioned in connection with the softening point, the combination of this with expansion can yield a workable control system. However, it must be emphasized that at least two properties must be measured if the indicated correction to batch is to approach uniqueness. Sometimes a third test is required. This need will be discussed under density and electrical properties.

(b) *Expansion Curve.* From the standpoint of straight day-to-day composition control, the expansion curve has little to offer that the average 0-300°C. coefficient lacks and, in addition, is a slow, difficult test that fails to meet criteria #1 and #4. Only with extreme care does it meet the needs of #3 and in rare cases only does it satisfy #2. However, it will be discussed briefly here because in spite of its limitations it is so frequently employed, and because it does have considerable meaning in certain special customer applications.

As previously stated, the 0-300°C. expansion test is precise to about 3×10^{-8}°C., which is equivalent to an uncertainty of about 1°C. in high expansion glasses and/or about 10 parts per million in the measurement of relative length at the two temperatures. It can be shown that the interferometer method for determining expansion curves requires the greatest care, not only in the design and preparation of samples and in fringe observations, but also in the matter of temperature measurement to attain the same order of precision. Other methods, employing samples up to 1 foot in length and direct microscope observations of length variation, are more precise but require elaborate precautions and consume considerable time in the complete determination.

Except in rare instances when the heating curve of a sample with special thermal history is desired, instead of a curve which is characteristic of a particular composition, the data must be taken either after a standard annealing treatment or during cooling from the annealing range at some standard rate. The latter is the preferred procedure. The cooling rate from somewhat above the annealing point is usually about 1°C. per minute since this is comparable to the rates employed in commercial annealing of articles involving glass-glass and glass-metal seals. Thus, with the aid of such curves, important information regarding seal stresses can be gained. However, it becomes evident that expansion curves play a more important role in research than in glass control.

To summarize regarding expansion tests, the following may be said:

(a) *Average Coefficient 0-300°C.* A very good and relatively simple routine control test which, along with softening point, goes far toward complete control data for the most common types of glasses.

(b) *Expansion Curve.* Not a good control test.

(3) *Density.* The writer has had little experience

with density as a control test although it has been employed extensively in other laboratories.

In most glasses, the change in density with composition is rather small and requires some care in its determination. Since the density is sensitive to thermal history, some standard annealing treatment is necessary. Thus, more time must elapse between melting and testing than is the case with softening point measurements. Whether density data can serve as well as expansion for the second control test depends largely on the type of glass involved. For instance, it is known that in lead glasses employed in electronic applications, density is frequently related rather closely to electrical resistivity. However, in such applications, the electrical properties are generally of sufficient importance to justify their measurement by direct methods.

To summarize, density tests cannot be regarded as much more than auxiliary determinations which may contribute to the running record but cannot indicate much regarding day-to-day composition control except in the case of glasses containing some heavy constituent such as lead.

(4) *Electrical Properties.* As implied earlier, measurements of electrical characteristics of glass are rarely employed in control unless such properties are of direct interest in the final application and the requirement is either critical or difficult to attain. Even in such cases, it is frequently possible to adopt softening point, expansion and density as the primary controls and to make occasional check measurements of the appropriate electrical properties to insure the effectiveness of the simpler tests. Such properties fall into two groups.

(a) *Direct Current Resistivity.* In almost all glasses the surface conduction exceeds the volume conduction at room temperature. Thus for electrical applications in which such temperature conditions apply, the glass should be chosen for its ability to retain good surface conditions in service. If this is done, measurements are largely useless because surface history is so important and can vitiate the measurement.

In high temperature applications, the surface resistivity becomes very great and the volume resisitivity assumes the predominant role. Such applications include stem presses in radio tubes where the temperature can be as high as 300°C. and the applied voltage in the order of hundreds of volts. A simple form of volume resistivity test involves a sample in cane form, perhaps 5 cm. in length, with wires sealed into the ends. This is placed in a suitable furnace and its resistance measured at elevated temperatures by conventional means. Since the resistivity varies rapidly with temperature, measurement of the latter constitutes the most important technical problem.

(b) *Dielectric Properties.* Here again, it can be said that, while the choice of composition is extremely important in dielectric applications, the control is not a very difficult matter. The dielectric constant varies only slowly with composition, temperature and frequency, and need not be followed on an absolute scale. This simplifies the preparation of samples in which the power factor can be measured with a suitable bridge at whatever frequency is regarded as necessary.

Summarizing with regard to electrical properties, one usually finds that conventional control tests are adequate if occasional check measurements are made for the electrical properties of interest in the final application.

(5) *Optical Properties.* There are two independent kinds of optical properties that sometimes require control of the glass:

(a) *Refraction.* In optical and ophthalmic glass applications, the refractive index and dispersion are usually specified with appropriate tolerances. Since such glasses are now largely produced by continuous melting, frequent testing must be employed to insure that the tolerances are met. The control procedure must include some kind of standard annealing procedure, as well as a knowledge of the relation between the index introduced by that procedure and what will be attained in the final anneal which the ware requires. Several standard types of refractometers are available, each of which calls for a particular geometry of sample and measures to its own degree of precision.

(b) *Transmission.* Many applications call for a certain color or certain transmittances at specified wavelengths. Such applications include signal ware, color filters, sun glasses, ultraviolet or infrared devices, etc. For glass control in continuous melters, as contrasted with ware testing, samples generally consist of drawn or polished flat glass. A standard thickness may be employed or the observed transmittance may be corrected to standard thickness. Color tests may consist of comparing such samples against standards that represent limits of chromaticity and luminous transmission, or the visible transmittance curve may be employed for calculating these characteristics. For other applications, it may be sufficient to simply observe the transmittance at specified wavelengths. A variety of commercial instruments are available, both for special transmission observations and for automatically drawing the entire curve. The wavelength ranges of such instruments extend from 200 millimicrons to several microns.

To summarize regarding optical properties, it is frequently necessary to adopt refractive index or transmission as primary control tests. However, it should be pointed out that softening point and expansion tests should be made occasionally to insure that optical control has not altered these properties as to interfere with the melting, annealing and sealing characteristics.

The Use of Control Data

Glass compositions are so varied and complex, and continuous melting units are susceptible to so many disturbing factors, that it is next to impossible to state any specific or quantitative rules by which test data are translated into control action. The qualitative effect of variations in major constituents upon the viscous and expansion properties are so well known that they need not be discussed here. We shall therefore adhere to broad principles.

Control tests should be three or four times as precise as the operating tolerances imply. If the tolerances are very close, then greater precision must be attained in the means by which the existence of trends is established, either by more careful testing or by statistical procedures employing larger numbers of more frequent samples.

Assuming adequate precision, the most important principle of control may be simply expressed: Avoid becom-

(*Continued on page* 512)

TYPE AND DESIGN OF REFRACTORIES FOR GLASS MELTING FURNACES

By J. A. JOHNSON

Findlay Clay Products Company, Washington, Pa.

The subject I have chosen for today's paper may sound rather broad in coverage, but I plan to stick pretty close to my assigned categories of pots, day tanks, refiners and bottoms. I will attempt to cover these categorically in the order in which I have listed them.

Although glassmaking is one of the oldest trades of man, until a few short years ago a very large portion of all glassware was made in pots either open or covered. In a period of just a few short years, we have seen pots relegated to a rather minor place in the industry, and they are used now almost entirely in the making of tableware, novelties and scientific glass instruments. Today, there are only three major manufacturers of pots in the United States and, of these, only one still shapes their pots by hand; the other two now cast their pots.

The ultimate goal of a pot used, of course, is to make as much good glass in as short a time as possible, but to break this down into the three desirable qualities of a pot: (1) easy heat-up or arching, (2) long life and (3) good glass. To attempt to achieve these three qualities, considerable work has been performed on both a laboratory and service test level. For a pot to be easy to heat up, a rather loose or open body is indicated. However, to achieve long life and good glass, a very tight and dense body is indicated and also one with minimum of impurities. You can readily see that it is impossible to achieve a dense and open body in the same pot, so we must endeavor to strike a happy medium. At the present time, to overcome this, it is necessary to give the pots a longer and more even arching period than has been the common practice. This arching period now appears to require from 12 to 14 days and it is an absolute must that the arch be very tight so that all portions of the pot reach the same temperatures at the same time, or as near possible as this condition can be achieved. There are distinct advantages to be gained by forming a pot by this casting. Namely, a more dense body made of low impurity clays which readily transmit heat, resulting in the pot coming around more rapidly than pots made by the hand method. This allows the glass manufacturer to get more melts in the same time from the cast pot. It also results in a fuel savings in that he can reduce the temperature in his furnace and still have a high temperature inside of the pot. This reduced temperature also will tend to give the pot longer life.

Day tanks are generally used in a similar field as that of pots with the exception of scientific instruments and the addition of lighting goods. In the past, day tanks have generally been rectangular in shape and have been built of slip cast blocks, primarily designed for use in continuous furnaces below the metal line. Above the metal or glass line, these tanks are usually built of a refractory or sillimanite type mix that will more readily withstand the temperature changes and the direct impingement of the flame against the block.

Again, the ideal block for a day tank would be a dense, low impurity block that would readily withstand temperature changes, and we again get into the fact that we cannot have a very dense block that will withstand spalling as readily as an open block. Part of this difficulty may be overcome by the method of operating a day tank, which I will discuss later. At the present time, most day tanks are of three basic types: that is, the burner on one end and the stack at the other with a straight through fire; second, the tank with the "U" burner, that is the burner and stack on the same end; and third is the new or rather recently designed day tank which is either round or elliptical in shape in which the burner is tansgential and the flue or stack is adjacent to that burner. This latter tank was originally designed and used by the Phoenix Glass Company at Monaca, Pennsylvania, and has proven very successful.

To overcome or to alleviate these spalling characteristics of the block, we recommend that day tanks be filled intermittently, that is, the tank filled about one-half of its fill and some heat put on the batch until it comes up to a red heat, and then the balance of the fill placed in. The batch is then heated up slowly for a period of time and the burner opened to bring the glass to melting temperatures. This actually serves two purposes. It prevents the blocks from spalling or breaking off in the furnace, and also allows the low temperature melting fluxes in the batch to pick up silica and soda and stay in the batch instead of running to the bottom of the furnace and attacking the bottom refractories.

One of the difficulties in building a round or elliptical day tank has been the necessity for cutting the silica brick to build a dome crown. We have developed at Findlay Clay a monolithic crown which can be cast much as concrete is poured on a wooden frame. This crown is allowed approximately one week for a set and is burned in place. In the one installation that we have tried it, it has worked very successfully to date. Another advantage of this type of day tank is the ease at which the crown can be lifted from the sidewall and the blocks replaced. The crown can be lowered back on the blocks and be ready for another fire without rebuilding the crown. This results in a considerable savings in labor.

It is difficult to discuss any one portion of a continuous glass melting furnace without overlapping a degree or two. However, I will again try to stay in my allotted fields. In discussing the refractories or the refining end of the furnace, it is usually assumed that the corrosion and/or erosion are not as great as in the melting end. However, at the same time any impurity that may enter the glass at this point will remain as an impurity and will result in a piece of discarded ware or cullet. It is, therefore, much to the glassmaker's advantage to use a liner in this area that will throw the least amount of impurities. Refining ends are known for the special shapes required. A clay block may be machined accurately after burning and thus assure a good fit in the construction.

(*Continued on page* 514)

Presented before the Fourteenth Conference on Glass Problems, University of Illinois, Urbana, Illinois.

SILK SCREEN PRINTING WITH BRIGHT GOLD

By R. J. MILLER, Director

Hanovia Chemical & Mfg. Company, Ceramic Division, East Newark, N. J.

Genuine gold can be silk screen printed on glass or glazed ceramics which after firing to temperatures ranging from 1050°F. to 1480°F. results in a mirror bright gold of 22 kt. gold. This metallic film, although extremely thin—less than 4 millionths of an inch—resists abrasion and solvents. A slight rhodium content lends hardness and brilliancy and the firing fuses the gold film to the glass or glaze with a firm bond. Because of the thin deposit, the actual cost of the gold print is often less than 1 cent depending on the area covered. One hundred grams of squeegee bright gold covers approximately 30 sq. ft. The gold preparation which is known as squeegee gold is carried in suitable organic vehicles which burn off in the firing process. Its consistency is jelly-like and while sufficiently pliant for fast screening, it sets immediately in a sharp print of fine detail. On automatic screening machines the production usually runs from 50 to 60 prints per minute, depending largely on the operator's ability to feed the ware. The gold prints can be conveyed directly to a lehr or kiln for immediate firing or may be stored for any length of time.

The Screen

The silk screen structure is vital to good results with bright gold. A special silk is recommended for gold screens. An imported hand-loomed silk is available in which each single strand is twisted to give more tensile strength and make for minimum thickness. Our gold screening silk is 200 x 168 mesh count, but its principal virtue is its very thin depth which in effect controls the deposit of gold. With accurate micrometer calibrations, the comparative thickness of various screen materials ran from 20% to 37% thicker than the special gold screening silk.

Likewise, it is important that the film which blocks out the non-design area of the silk screen be kept to a minimum thickness. The ideal film would be one in which no measurable depth is added to the silk. We have measured a dozen gold screens from various sources and found them to vary in film thickness, in addition to the thickness of the silk, from absolute zero to 0.0018". The prints obtained from the "zero" screen were sharp and mirror bright, whereas the thicker screens deposited an excess of gold which tended to lose some of the fine detail and fired out slightly dull. The coverage, or material cost of the gold per print, is also a factor in favor of the thin deposit since the cost rises in proportion to the thickness of the screen. We found that film thickness beyond 0.0010", in addition to the silk depth, tends to produce a puddled effect with a mottled, dull-fired finish.

In applying the emulsion backing in the direct screen method, it is advisable to apply the first coating on the inside of the screen. Coatings thus applied effect an anchorage for succeeding applications after drying. Firm and uniform pressure in the application of the film to the silk creates a continuous and stronger bond. A metal coating trough photo solution is very effective in applying a uniform coating of emulsion. The screen should be held at a steep angle and the trough containing the emulsion is held against the silk and brought upwards quickly but firmly. The edge of the metal trough should be smoothed with emery cloth so as to prevent injury to the silk. More than three film coatings are usually too thick for sharp detail and thin deposit of squeegee bright gold. Some film preparations are sufficiently durable and thin with only one inside and one back application. A screen with very thin backing can be made more durable by immersion in a hardening agent for 30 minutes without adding measurable depth.

Screens made by the indirect method of exposing and developing the design on a sheet of photo film before it is applied to the silk are finest in detail and print with clean, sharp edges. It is also possible to control the thickness of the film by the time of exposure. Direct method exposure of the silk and the brush-on type of emulsion film tends to produce a slightly jagged or serrated edge on the print due to the mesh of the silk. However, this is hardly noticeable, excepting where very exacting and legible lettering is required as in the instance of labeling on small cosmetic bottles and vials.

Consistency of Gold

We have found that for rapid screen printing with gold, 45–60 prints per minute, a rather stiff consistency of gold is required. Severe heat or prolonged agitation tends to break down the gold gel. A thin or soupy consistency tends to deposit an excess of gold. In such a fluid state air bubbles are often entrapped which do not always pop out in the firing and thus leave permanent little blotches in the fired gold film. It is therefore advisable to place only a moderate supply of gold in the screen and add more when necessary. Squeegee gold, which has been removed from the screen and returned to its jar, tends to regain its original consistency and workability if stored in a cool place.

Squeegee gold that is too dry and stiff produces mesh marks in the print that do not flow out entirely. The fired appearance is apt to be on the weak side and lacks full color and flash. A small addition of oil of lavender or high flash naphtha mixed in with the stiff gold will lower the viscosity and correct this condition. This condition might also occur with a slow rate of screening or with hand screening.

Firing

Firing temperatures are determined largely by the composition of the article screened. Ceramics, such as tiles and lamp bases, are fired at 1250°–1375°F. depending on the hardness of the glaze. Glass temperatures range from 1050°F. to 1250°F. However, the most widely used firing range for glass is from 1080°–1140°F. The general rule is to fire as high as the glass will stand without distortion. The higher the fire, the better the adherence.

(*Continued on page* 510)

GLASS ANALYSIS TIME REDUCED FROM 1½ DAYS TO 2 HOURS

One of the important factors in the successful continuous manufacture of glass products is the control of viscosity of the melt. Sodium and potassium oxide content are significant factors in adequate viscosity control. A difference of 0.2 per cent sodium oxide, for example, can mean the difference between satisfactory and unsatisfactory glass bottles. Furthermore, excessively high viscosity of the melt will substantially lower the production rate.

Since information on sodium and potassium oxide content is needed immediately after a melt is made, it was found absolutely essential to use a method which provides fast and accurate results. The standard gravimetric methods for these two oxides are extremely time-consuming and the cost of required reagents is significant when large numbers of samples must be analyzed. Furthermore, the chloroplatinate method for potassium frequently provides results of less than desired accuracy. Since the gravimetric analysis of three glass samples for sodium and potassium oxides requires approximately one and one-half days, this method was found to be completely useless for process control. It also provided data which had only historical significance.

Glass Containers, Inc., Los Angeles, California, has developed a rapid and accurate method for the routine control of sodium oxide and potassium oxide using the Beckman Model B Spectrophotometer with flame attachment. This new flame method has cut analysis time by a factor of fifteen. Maximum total time for analysis by flame photometry is two hours, including sample preparation, standardization and rechecks, if necessary.

The procedure consists of dissolving a .100 gram glass sample in 2.5 ml 48 per cent HF and 1 ml concentrated $HClO_4$. The mixture is heated at 110 degrees Centigrade to remove excess HF and to completely dissolve the SiO_2. The residue is then dissolved in dilute HCl. Approximately one hour is required for these steps. Glass Containers, Inc. has found that dilution of the dissolved sample to 100 ml gives a sodium oxide concentration of about 150 ppm and a potassium oxide concentration of about 5 ppm. Calibration curves are prepared from synthetic standards of sodium chloride and potassium chloride mixtures. Since sodium interferes at 768 millimicrons when it is present in larger amounts than K, it is necessary to prepare blanks containing both sodium and potassium to correct for this interference.

Readings on the spectrophotometer for sodium are taken at 589 millimicrons with a blue-sensitive phototube and for potassium at 768 millimicrons with a red-sensitive phototube. Very steady readings are obtained for potassium oxide at approximately 3.4 pounds acetylene pressure; sodium oxide readings are taken at a somewhat higher acetylene pressure to minimize needle fluctuations.

Accuracy for potassium oxide is better with flame photometry than with the gravimetric method when there is less than 5 per cent potassium oxide in the sample. For sodium oxide, accuracy to plus-or-minus 0.15 per cent can be obtained in the range of 14 to 16 per cent sodium oxide. Sodium and potassium contamination from glassware is not serious since the concentrations of both of these ions are relatively high in the samples under test.

The flame photometric determinations of sodium and potassium are only two of the many uses of the Beckman Model B Spectrophotometer at Glass Containers, Inc. This versatile instrument is also relied upon for color evaluation of glass products and determination of silica, iron and alumina at various processing stages.

NATIONAL BUREAU OF STANDARDS NAMES DIVISION CHIEF

Dr. Irl C. Schoonover has been appointed Chief of the Mineral Products Division of the National Bureau of Standards, according to an announcement by Dr. Allen V. Astin, Director of the Bureau. Dr. Schoonover, formerly Assistant Chief of the Organic and Fibrous Materials Division and Chief of the Polymer Structure Section, succeeds Dr. Herbert Insley who retired in January.

Dr. Schoonover received his B.S. degree from George Washington University in 1929 and his M.S. and Ph.D. degrees from Princeton University in 1931 and 1933 respectively. During the latter time he held a Merck Fellowship. His principal work was in physical and analytical chemistry. Except for the time spent at Princeton and a year as Professor of Chemistry at Davis and Elkins College in 1933, Dr. Schoonover has been employed by the Bureau since 1928.

• Mr. Fritz Heller, President of the Manufacturer's Association of Czechoslovakia during most of its prewar existence, celebrated his 75th birthday on June 16, 1954, at his home in Gresten Austria. Mr. Heller would like to extend his thanks to his many American friends who sent their congratulations on this occasion.

SAFETY COUNCIL TRAINING LEAFLETS

"Accident Preventers", the National Safety Council's new employee training leaflets, are packed with illustrations and sound tips on how to stay safe on the job. Using few words, but plenty of colorful cartoons, the preventers teach safety to today's worker who is accustomed to the fast visual presentation of television and the picture magazines.

Here is a pocket-size library of safe principles and practices on lifting, housekeeping, clothing and hand tools which can be used in many ways. They may be distributed at safety meetings, passed out by foremen, enclosed in pay envelopes or made available for pick-up at the time clock.

CONFERENCE ON QUALITY CONTROL

The Eighth New England Conference of the American Society for Quality Control will be held at the Ten Eyck Hotel, Albany, New York, on October 21, 22 and 23, 1954.

A new feature of the Conference will be a management seminar on quality control conducted by three industrial consultants in this field. Clinical sessions, education programs and factory visitations have been arranged.

ALKALIES AND GLASS: ALLIED INDUSTRIES

By H. W. HARRINGTON and R. V. YOUNT

Solvay Process Division, Allied Chemical & Dye Corporation, New York, N. Y.

Scope of the Alkali Industry

In our complex civilization, interdependence of industries is the universal rule. With the alkali industry supplying one of the three basic raw materials necessary for glass, these two industries have a particularly close relationship. Nearly one-third of the U. S. production of soda ash is consumed in the manufacture of glass. It is not at all surprising, then, that the alkali industry is extremely interested in the future of glass.

Alkalies are essential in the production of nearly all types of glass. In the manufacture of most flat and hollow ware, alkali is the highest costing raw material. This being so, the welfare of glass and the degree of success attained in its struggle with competing materials are dependent to a degree on the efficiency and quality of the products produced by the alkali industry. A steadily expanding market for alkalies is very healthy for glass. Each industry has excellent reason to wish the other all the luck in the world.

When the glass manufacturer considers alkali, he is likely to think first of soda ash, and then of salt cake and sodium nitrate. If he should be a producer of a high grade of stemware, tableware or any of various types of special purpose glasses, the potassium carbonates, calcined or hydrated, and potassium nitrate come to his mind. These are the products of the alkali industry which are of chief concern to the glassmaker.

There are other alkali compounds, many of them produced in large tonnage. These include sodium hydroxide, sodium bicarbonate, sodium sesquicarbonate and sodium nitrate, as well as numerous other sodium derivatives running to lesser tonnages, and certain ammonium compounds.

A comprehensive picture of alkali consumers is unnecessary and would require too much time, but a few highlights may be cited. The chemical industry is its own best customer. A manufacturer of sodium or potassium compounds will utilize as his source of the element the carbonate, hydroxide or chloride for reasons of economy and availability. The phosphate, silicate, chromate and soap industries are examples, to mention a few.

Consumption of soda ash by the steel industry for desulphurizing is steadily increasing. One ton of soda ash is required to produce four tons of aluminum. Rayon manufacture utilizes large tonnages of sodium hydroxide. Paper is an important consumer of soda ash, sodium hydroxide and salt cake. The fertilizer trade takes the major portion of the sodium nitrate supply. The textile industry is a large consumer of sodium hydroxide and soda ash, almost without regard to the type of fiber involved.

Soap utilizes sodium hydroxide, soda ash and potassium hydroxide, as well as considerable radio and television time. This same industry is the producer of most of the assorted detergents, cleansers and water softeners which crowd the grocers' shelves, and have largely as their bases the sodium alkalies. The field of alkali usage could readily be expanded much further, but presently we are interested in alkalies as applied to glass manufacture.

Presented before the Fourteenth Conference on Glass Problems, University of Illinois, Urbana, Illinois.

History and Process

Soda ash is the alkali of greatest importance to the glass industry. In 1791 the Leblanc process was patented in France. It was the first process for the production of synthetic soda ash, and represented a tremendous advance for a world which had previously depended on the leaching of ashes for its alkali. The raw materials were salt, coal and acid. However, the process was expensive and wasteful, and the soda ash was of low and fluctuating purity.

In 1865 Ernest and Alfred Solvay put into commercial operation at Couillet, Belgium, a process of soda ash manufacture by the reaction of ammonium bicarbonate with salt brine. This process required large quantities of salt, limestone and coal, with a plentiful supply of water.

In 1881 rights to use this process in America were obtained by Rowland Hazard, a Rhode Island Textile manufacturer, and W. B. Cogswell, a mining engineer. The company they formed, then known as The Solvay Process Company, constructed a plant at Syracuse, N. Y. In January 1884, this plant produced its first soda ash, and the alkali industry had come to the United States.

The process employed by the entire industry for the production of synthetic soda ash today varies only in detail from one plant to another, and is fundamentally that which the Solvay brothers initiated in Belgium 88 years ago. No more economical method has been devised. The process itself is interesting, but like many such chemical operations is difficult of verbal description. For that reason a flow diagram of the ammonia-soda process is shown in lieu of a time-consuming description. This can be studied at leisure, and we will pass on to the matter of soda ash production and the part played by the glass industry as a customer.

Production Data

In terms of the output of the American alkali industry, glass consumes very close to one-third of the soda ash, at least half of the potassium carbonate and about one-ninth of the salt cake. The glass industry's requirements of sodium nitrate represent only a very small percentage of the total tonnage.

In 1880 the domestic production of glass of all types was 227,688 tons, having a value of $21,154,000. In the same year, $5,133,000 worth of glass was imported. That total provided 11.3 pounds of glass per capita at a cost of $.524. In 1947 our domestic production had increased 32 times to 7,296,324 tons, with a value 46 times greater or $970,931,000. Our imports had increased only 8% in that time. However, the after-effects of World War II probably exerted considerable influence upon this figure. Our per capita consumption of glass had increased ninefold to 101 pounds, with 13 times the value or $6.74. The glass industry came a long way in those 67 years, and

the alkali industry must be credited with having made an important contribution to this record.

In 1880 a poor quality of soda ash was very expensive, about $63.00 per ton, and those were uninflated dollars. The ammonia-soda process made a high quality product available in adequate quantities at a much lower price. That its effect contributed to a wider use of glass, along with mechanization of the industry and increased manufacturing efficiency, becomes apparent when we note that the composite price per ton of finished glass increased only 43%, from $92.91 to $133.07, in the same period. You will look far to find other commodities which have increased only 43% in price in those same 67 years, and while there were many factors responsible for this achievement, the fact that soda ash prices in 1947 were less than half what they had been in 1880 for a higher quality product, certainly played a part. Further, this price increase is dwarfed when one contemplates the vast improvement in quality and serviceability of glass which has been accomplished since 1880.

During the five-year span from 1947 to 1952, the value of domestic glass production has jumped 50% to bring glass slightly above the one and one-half billion dollar mark in value. There is every reason to believe that this healthy rate of growth will be continued.

Status of Future Supply

The present capacity of the alkali industry seems capable of meeting adequately the requirements of other industries. Short of total war, the same should hold true for the immediately foreseeable future—specifically, for the next two years or so. Beyond that, any prediction would be mere conjecture.

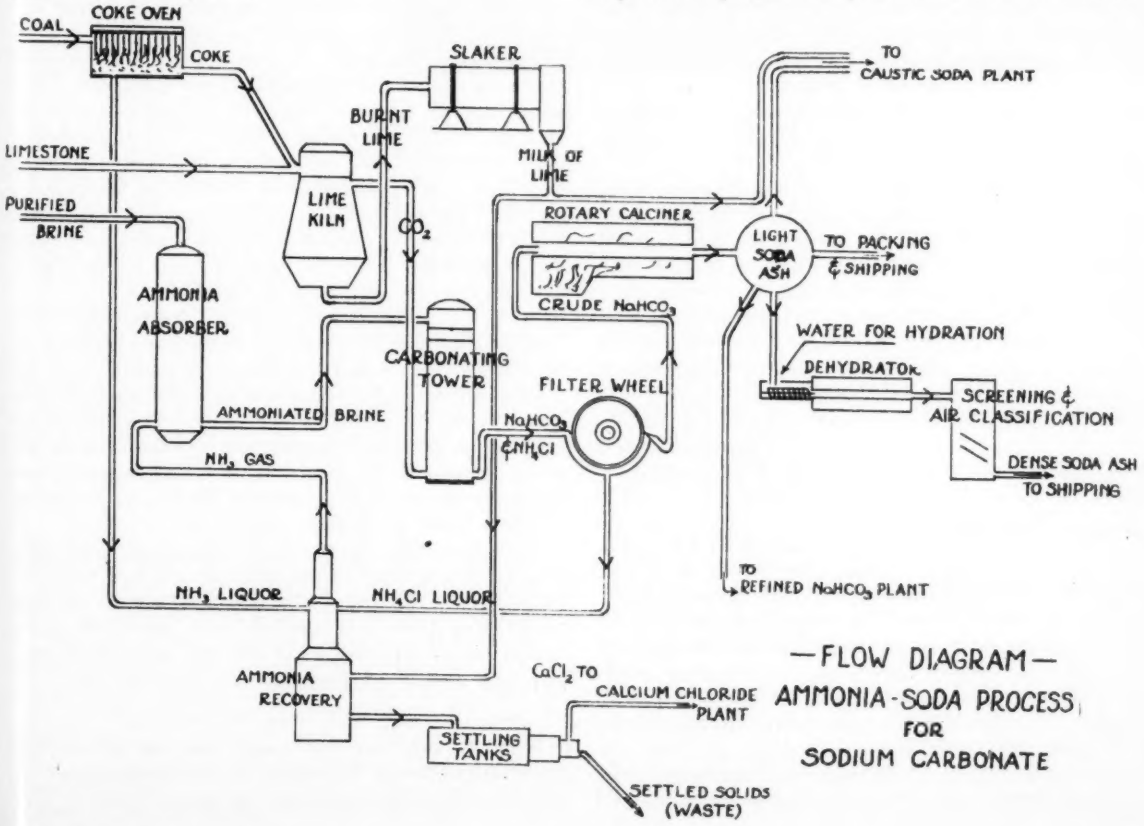
A steadily increasing chlorine demand has furnished the impetus for the release of a large tonnage of soda ash formerly diverted to the manufacture of caustic soda. The electrolysis of salt brine supplies both chlorine and caustic soda. With the diversion of soda ash to caustic soda production becoming progressively less, the supply of soda ash available for other industrial uses will be correspondingly increased.

The potassium carbonate capacity which is forecast for 1954 is about 80% above production in 1951, and 65% over estimated production for 1953. Due to the cyclical nature of the demand for potassium carbonate, it is admittedly rather difficult to predict future consumption levels. However, it is expected that the increased capacity estimated for 1954 will ease the situation and provide an adequate supply for the immediate future.

Quality Control

Quality control in the alkali industry is of great importance, and this paper would not be complete without some consideration of that subject. Due to time limitations, a detailed description will not be attempted and our discussion will be confined to soda ash production. Comparable safeguards for quality control are standard practice in the manufacture of the other alkalies utilized by glass. Since all soda ash except that obtained by processing and refining of natural deposits is made synthetically by the ammonia-soda process, it is believed that our discussion will apply equally well to all producers.

Control tests and procedures have two main objectives, both of equal importance. In the first place, they are designed to guide and assist the operators in maintaining the process at peak efficiency at all times. This makes for



—FLOW DIAGRAM—
AMMONIA-SODA PROCESS
FOR
SODIUM CARBONATE

maximum economy of operation, and is of advantage pricewise to all consumers.

The other objective is the maintenance of consistently high quality and uniformity in the product, and the prevention of objectionable contamination.

Starting with the salt brine, control is maintained by frequent sampling at numerous points prior to, during and after the brine purification operation. When the purified brine enters the process, a high degree of accuracy is imperative and must be maintained clear through to the end product.

In the ammonia absorber towers, the precarbonators and the carbonating towers, frequent samples are taken at numerous key points for determination of CO_2, chloride, ammonia and corrosion inhibitors. The latter are required to insure against iron contamination of the soda ash. Accurate temperature control at all points in the system is a vital factor.

The same determinations are made at frequent intervals on the slurry from the carbonating towers, together with tests to establish the completeness of the conversion to $NaHCO_3$. The efficiency of the entire process hinges upon the results here obtained.

Close check at all times on the charge to the calciners is essential, as is also accurate temperature control throughout the calcining operation. The discharge is tested hourly for $NaHCO_3$, which should be absent.

At practically all points where samples are taken, on-the-spot tests are made hourly by the operators. Portions of each sample go to the plant laboratory for check tests, and for determinations of such other constituents as are vital in maintaining adequate control. Any deviation in tests from permissible limits calls immediately for additional samples and tests, plus corrective operating measures, until conditions are again normal. Personnel and facilities to cope with such situations are held in readiness at all times. Automatic controls of various types, and instrumentation for the indication or continuous recording of compositions are employed wherever possible and practical throughout the system.

This eternal vigilance is of great importance to alkali customers. The glass manufacturer must have soda ash of dependable and uniform composition and physical characteristics or his troubles will be multiplied. Our modern soda ash introduces less contamination into glass than any other batch material employed in more than minor charges. The same statement holds true for the domestic potassium carbonate used in the production of potash glasses. Both salt cake and our domestic synthetic sodium nitrate, as differentiated from the naturally-occurring imported Chilean nitrate, likewise possess a high degree of purity and uniformity of composition.

Shipping and Storage

Soda ash is shipped in bulk in either hopper or box cars, and in 100-pound multi-walled paper bags. It gradually absorbs moisture and CO_2 from the atmosphere, the rate increasing with relative humidity and temperature. This absorption takes place in a thin surface layer at the point of atmospheric contact, with attendant caking and lumping. This caked surface layer serves as a protective film for the interior soda ash.

In the glass industry, bulk shipments are generally consumed so quickly that this absorptive property of soda ash presents little or no problem. In the past several years, because of recurrent soda ash shortages, many glass concerns have resorted to bag shipments to supplement their bulk storages, and to provide increased stock to tide them over possible emergency periods of shortage. Such bag stock should preferably be used and replaced with fresh at about six-month intervals.

Hydrated and calcined potassium carbonates are generally packed and shipped in 100-pound multi-walled paper bags or in barrels. In some instances, bulk shipments of calcined have been made in tight hopper cars, where the rate of consumption warranted it, and a suitably tight storage at the plant has been provided.

The potassium carbonates are deliquescent. Unless protected from the atmosphere, they absorb moisture with consequent caking and decrease in the per cent K_2O. Hydrated is more prone to caking than is calcined. Dry storage should be provided both for bulk and packaged material. Between withdrawals, the product remaining in packages should be covered or otherwise protected from the air.

Salt cake is generally shipped in bulk. In the past this material has been especially subject to caking, but recent advances have greatly improved the product in this respect. Sodium nitrate is usually taken by the glass industry in 100-pound multi-walled paper bags, although it can also be shipped in bulk. It has little tendency to cake in dry storage unless kept for prolonged periods prior to use.

Research, Development and Service

The several producers that make up the alkali industry maintain well-staffed and well-equipped research departments of competent chemists, engineers, physicists and technicians working constantly on problems of process, improvement of products, increased efficiencies, economy measures, and the development of new products. Their efforts provide insurance that you will receive consistently alkalies of high and uniform quality, and at the lowest price compatible with maintenance of this quality level.

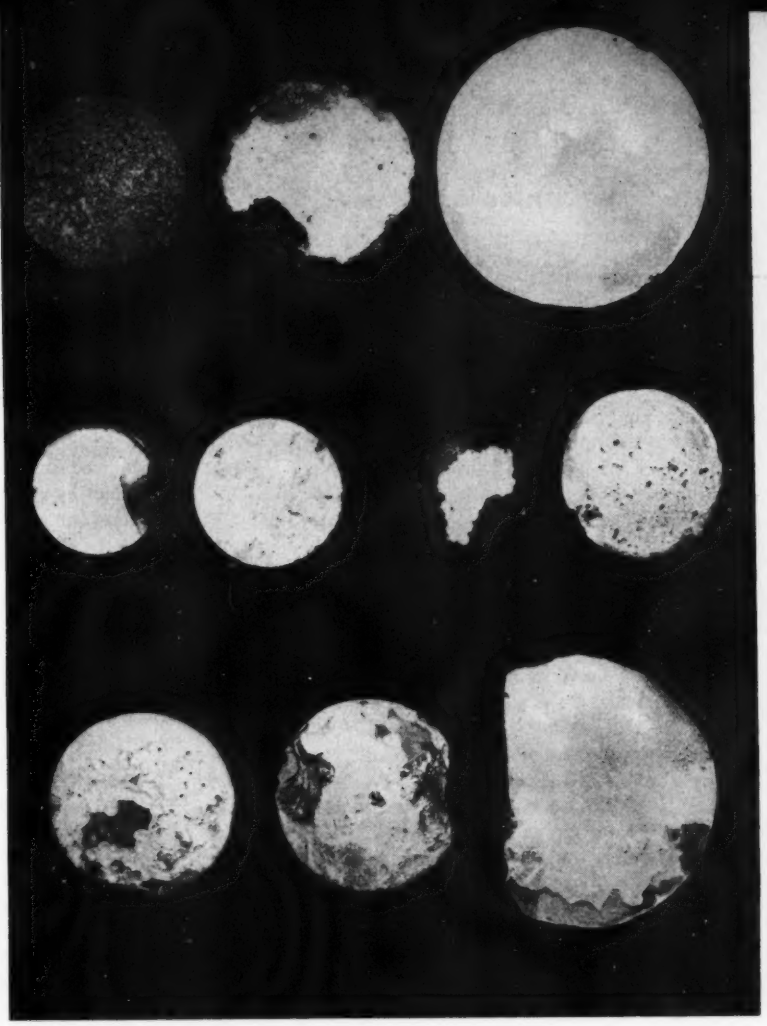
Certain alkali producers also have set up facilities for service to the glass industry which is supplied gratis upon request. These are manned by qualified glass specialists, and include the laboratory and physical testing equipment necessary to implement the service.

While the ammonia-soda process is basically the same as that devised many years ago in Belgium, constant research has contributed countless refinements and improvements which have brought soda ash production to its present efficiency and dependability. As a result, standards of purity have progressively increased over the years, uniformity has been steadily on the upgrade and the price structure has benefited by the never-ending efforts to lower production costs.

Research by the alkali producers also deals continually with the development of new products and new fields for the utilization of alkalies. The increased alkali consumption arising from these projects, with the resultant expansion of the industry, is directly beneficial to all consumers of alkali, including your own glass industry.

• Ralph K. Behr has been named Manager of the Boston District Office of Babcock & Wilcox Company's Boiler Division. Mr. Behr joined the company in 1928.

LENSES — 300 B.C.



The January 1926 issue of the *Bausch & Lomb Magazine* announced that lenses as an aid to vision, held on the face by some sort of frame, had been found in excavations in ancient Carthage. No more details were discovered until recently when it was suggested that Bausch & Lomb write to the White Fathers in Tunis. Lenses had been found and, although it is now believed they were not spectacle lenses, they are of considerable historical interest.

Thanks to Father R. P. Ferron, Director of the Lavigerie Museum, for his help; and to G. Lewis Jones, the American Consul General of Tunisia, who took personal interest in acting as liaison between Bausch & Lomb and the French-speaking priest.

* * *

Near the North African city of Tunis in a white building on top of a gently sloped but commanding hill, several lenses believed to be the oldest in the world are on display.

The hill, for many centuries known as the Byrsa, is the original site of ancient Carthage. The lenses were found here during the early 1900's in several Carthaginian graves which unquestionably date from the period between 300 and 400 B.C. They are kept today in the Lavigerie Museum of the White Fathers of the Desert, in the particular charge of Father R. P. Ferron, Director of the museum.

Eight of the lenses are glass—bubble-filled, but nonetheless real glass. The other two are polished rock crystal. All the lenses are roughly circular, with a definite convex surface. They range from about 1¼″ in diameter —the size of a modern spectacle lens—to ¾″. Any trace of mountings they might have had, perhaps of wood or ivory, have long since disappeared. Time and the action of the soil have coated eight of the lenses with an opalescent patina of mottled, pearly white. The cleanest of them, one of the smallest, is still highly polished and has a magnification of about 4×.

Although many other burial grounds in the region have yielded archeological treasures, the most ancient of the Punic tombs are those of the plateau of the Byrsa. After the defeat of Carthage by the Romans in 146 B.C., the city was destroyed so completely that practically the only objects that have been preserved are those which were already deep underground. The White Fathers have not kept exact records of their excavations, so the specific dates and places of the discovery of the lenses are not known. Father Ferron believes that they probably were not manufactured in this region of North Africa but were imported from Phoenicia in the East. The Phoenicians were famous for the manufacture of glass, which was one

(*Continued on page* 516)

Reprinted from *Bausch & Lomb Magazine*, Vol. 30, No. 1.

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

POLISHING OF GLASS

A series of papers on the polishing of glass was published in *Steklo i Keramika* (*Glass and Ceramics*) 10, No. 2 (1953).

I. E. Shapiro studied "*Formation of a Thin Opaque Surface Layer during Glass Grinding*" (p. 4).

In the course of polishing, both the abraded surface layer and the underlying layer of fissured glass must be removed. The former layer is usually 4 to 5 microns (i.e. 160 to 200 microinches) deep, and the depth of the second layer often is 15-17 microns (i.e. 600 to 680 microinches), if usual grinding discs of cast iron are employed. Thus, in the subsequent polishing, up to 22 microns must be removed from the glass surface. As the customary rate of polishing is 8-10 microns/hour, over two hours must be spent on the polishing process.

This process can be accelerated by altering the conditions of grinding so as to reduce the thickness of the layer damaged by it. This was achieved by substituting a plastic for cast iron as the disc material. The earlier tests by N. N. Kachalov indicated that polymethyl methacrylate was the most suitable material. New tests by Shapiro confirmed that methyl methacrylate polymer was superior to capron (a material similar to nylon) and to δ-cellulose. However, ebonite proved to surpass methyl methacrylate in some respects. Unfortunately, no specification is given for the ebonite (vulcanite, hard rubber) used.

For the laboratory tests, polished glass discs, 100 mm. (4 in.) in diameter, were used. The glass composition was SiO_2 72.0, Al_2O_3 1.2, Fe_2O_3 0.1, CaO 12.8, MgO 0.1, Na_2O 13.2, SO_3 0.3, F 0.3%. The glass was ground by means of a grinding disc, 65 mm. (2.6 in.) in diameter, whose working face had 6 radial grooves 2 mm. wide. The grinding discs were pressed to the glass by cast iron plates which established pressure of 170 g./sq.cm. (2.4 psi). They made 168 revolutions per minute. A corundum abrasive "M-14" was supplied at the rate of 4 g./min. This abrasive was suspended in 7 parts of liquid.

The tests were carried out as follows. First the glass plate was superficially ground until its whole surface acquired an opaque appearance. Then the glass plate and the grinding discs were, separately, weighed. Then the actual grinding continued for a time not specified in the original. Finally, the glass plate and the grinding disc were weighed again. If the difference between the masses before and after experiment was L_1 for glass and L_2 for the plastic material, then L_1/L_2 is Kachalov's "grinding coefficient". The greater the coefficient, the less plastic material is spent on removing a definite amount of glass.

Table I shows that L_1/L_2 was for ebonite approximately 2.6 times as great as for methyl methacrylate polymer. The specific gravity of ebonite was 1.19, and of methyl methacrylate, 1.17. Each value in the table is the mean of 3 determinations.

The smoothness of the surface ground when ebonite was used was as good as when the grinding disc was of methyl methacrylate polymer, and better than in the instance of iron discs. This is shown by the profilograms reproduced in the original paper and also by Table II in which the average deviation of the actual surface from the main surface is listed.

TABLE I

	Loss in weight (grams per hour) of		
	Glass	Plastic	L_1/L_2
Methyl methacrylate	1.97	3.67	0.54
Ebonite	1.92	1.34	1.43

TABLE II

Grinding disc	Roughness in microns	Roughness in microinches
Cast iron	0.71	28
Cast iron	0.81	32
Methyl methacrylate	0.40	16
Methyl methacrylate	0.42	17
Ebonite	0.43	17
Ebonite	0.38	15

The comparison between grinding discs of methyl methacrylate polymer and ebonite was repeated on a production machine. Glass sheets, 2000 x 750 mm., (i.e. 6.56 x 2.46 ft.) were first superficially ground by means of a cast iron disc and then finally ground with a corundum powder "M-14" on grinding discs of the test materials. The initial disc thickness was measured. Each side of the sheet was ground for 15 minutes. When the discs were worn so as to be unusable, their thickness was measured anew, and also the number of the sheets ground was counted. The results are gathered in Table III.

TABLE III

	Methyl methacrylate polymer	Ebonite
Initial disc thickness, mm.	35.0	16.0
Final disc thickness, mm.	6.5	4.0
Loss in thickness, mm.	28.5	12.0
Number of sheets ground	88	103
Loss in thickness per sheet	0.32	0.12
Roughness in microns	0.40-0.45	0.40-0.45
Roughness in microinches	16-18	16-18

It is seen that ebonite was abraded much less than methyl methocrylate, and that the surfaces produced were equally smooth. As ebonite also is less expensive than methyl methacrylate polymer, it seems to be the material of choice for grinding discs.

* * * *

"*A Method of Studying and Estimating the Surface*

Quality of Ground Glass" was described by Yu. A. Brodskii, p. 7.

The method is based on application of a profilograph. The profilograph constructed in the All-Union Institute of Glass is described briefly. The stylus is a diamond pyramid with four faces forming angles of 90° with each other; the apex of the pyramid has the radius of curvature of 2.5 microns (100 microinches). The stylus presses on the glass surface with the force of 0.10-0.12 gram-weight. It can be carried over the surface at any one of 3 speeds, namely 2.5, 6.6 and 192 mm./min. (0.1, 0.26 and 7.6 inches/minute). The vertical displacements of the stylus, caused by its sliding over the hills and valleys of the surface, are electrically magnified and transferred to a pen which marks them on a moving paper ribbon. The magnification of these displacements can be varied in 5 steps between 2000 and 100,000 times. The total horizontal displacement, i.e. the length of path traversed by the stylus in a test, is 5 to 6 mm. (0.2-0.25 in.). This displacement is magnified 50 to 200 times when transmitted to the writing pen.

Another part of the instrument calculates, from the profile curve, the average deviation of the real surface from the main plane. Some values obtained in this manner are listed in Tables II and III above as "roughness".

* * * *

"*Polishing Stars of a New Construction*" are advocated by M. P. Nolken, p. 9.

The new polishing device is illustrated in Fig. 1. The left-hand half of the figure is the plan, and the right-hand half is a part elevation of the machine. The main ring (*1*) is 600 mm. (24 inches) is diameter. It carries three axles (*3*). On each, a polishing disc (*2*) is suspended; the discs are 400 mm. (16 inches) in diameter each. The three discs almost touch each other. Thus, the diameter of the whole device is 875 mm. (35 inches). The discs can rotate on ball bearings and can tilt up to 3° from the horizontal. The center of gravity of each disc coincides with its center of oscillations. The pressure on the discs can be varied between 100 and 120 gram-weight per sq. cm. (1.4-1.7 psi). It is the sum of the pressure exerted by the weight of the polishing device and the pressure by the machine lifting the glass plate.

The advantages claimed for the new device include (1) the pressure is larger and more uniformly distributed than in the older types; (2) the discs are easily exchanged; (3) the space between the discs is small. Thus, the presence of a large cool area surrounded by hot areas (under the polishing discs) is avoided, which makes cracks less probable.

The new device was compared with a machine of the old type in production also. The results are collected in Table IV. It is clear that the new machine is in all respects superior to the old.

TABLE IV

	Machine	
	Old	New
Time of polishing 2000x730 mm. of glass (in minutes)	135	82
The number of sheets polished in time unit	19	25
Expense of felt, in grams per one side of sheet	53.1	43.4
Expense of crocus, in kg. per sq. meter of glass	1.40	1.14
Expense of energy, in kwh per one side of sheet	11.9	7.0

* * * *

The remaining papers are on crocus and thus a little outside of the field covered by THE GLASS INDUSTRY. They are:

"Manufacture of Crocus from Ferrous Sulfate in a Rotating Furnace" by A. G. Minakov, N. A. Semerenko and Yu. A. Brodskii, p. 11; "Crocus from the Dust of Roasted Pyrites" by A. P. Aleksandrov, Yu. A. Podlesnyi and N. K. Dertev, p. 15; and "Determination of the pH of Crocus Suspensions" by N. K. Dertev, L. E. Zlotnik and L. P. Fatikova, p. 17.

STRATIFIED STRUCTURE OF GLASS GOODS

I. V. Borovikov summarized his views on the structure

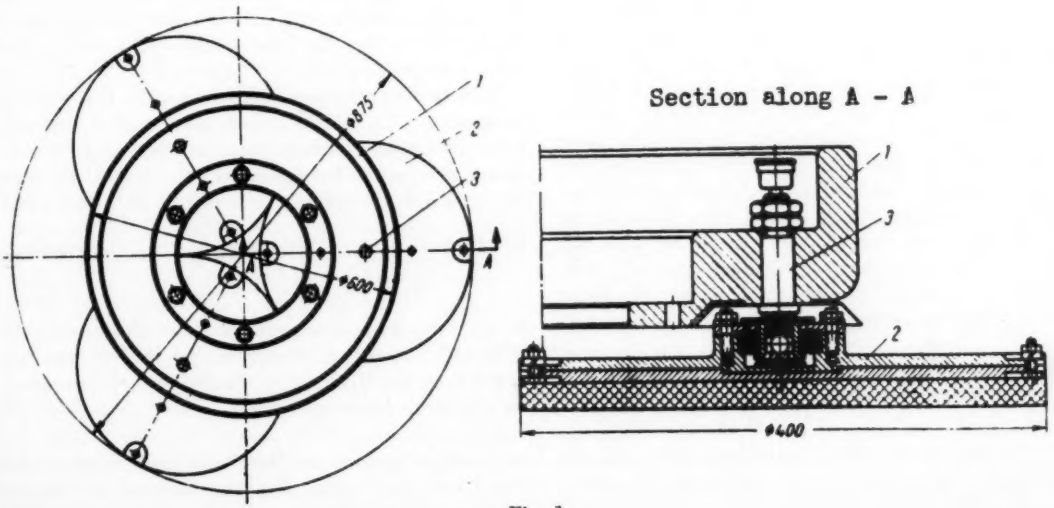


Fig. 1.

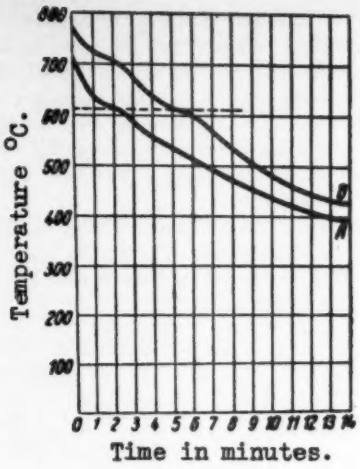


Fig. 1.

of glass goods in *Steklo i Keramika* (*Glass and Ceramics*) **10**, No. 1, p. 10 (1953).

If a glass sheet, a glass rod or a glass tubing is cut and the cross-section is examined in a polarization microscope, dark and light layers are visible. They are parallel to the boundaries of the cross-section. Thus, in a sheet they are straight and normal to the sheet thickness (except near the edges), and in a rod and a tubing they form concentric circles. The thickness of a layer may be as small as 0.0002 cm.

These layers are believed to originate from the transformation occurring in every glass when its temperature during cooling drops to a "critical temperature", different for each kind of glass. Window glasses have "critical temperatures" between 600° and 630°C., bottle glass about 620°, chemical glass of the "Pyrex" type 700°C., optical glass 570°, and so on. When a glass reaches its "critical temperature", transformation sets in and the heat evolved during transformation retards the cooling of the neighboring layer. Thus, stratification forms.

Fig. 1 shows the effect on a larger scale. A crucible containing about 35 g. powdered bottle glass was heated to about 750°C. and then allowed to cool. The temperature of the powder was determined by two thermocouples, of which one was near the wall and the other about 1 cm. inside. The abscissa of the figure represents the time (in minutes) after cooling has started, and the temperature (in °C.) is plotted along the ordinate. Curve A is for the thermocouple near the wall, and curve B is for the interior thermocouple. It is seen that the rate of cooling of the exterior layer decreased for a while when the temperature (curve A) reached 620°C. At the same time, the cooling of the interior also slowed down for a minute or so, although the temperature (curve B) was still 720°C., i.e. far above the "critical temperature". This retardation of cooling of the interior layer was due to the heat evolved during setting of the exterior layers.

A METHOD FOR DETERMINING THE BRITTLENESS OF GLASS

Such a method was worked out in the laboratory of Yu. A. Brodskii in the Russian Institute of Glass. Its description in *Steklo i Keramika* (*Glass and Ceramics*) **10**, No. 2, p. 27 (1953) is followed by an editorial note which points out that the method is tentative and invites comment of the readers.

The method is based on the assumption that the relative increase in surface area, occurring when the specimen is shattered in a standard manner, is a measure of brittleness. Thus, if a specimen, whose surface area is F_1, is fragmented and the total surface of the fragments is F_2, then the brittleness of the specimen can be expressed as $\frac{F_2 - F_1}{F_1}$. To calculate F_2, the fragments are sifted into 7 fractions. If the mass of a fraction is P, the average particle diameter in the fraction is d, and the specific gravity of the material is γ, then $F_2 = \frac{6}{\gamma} \Sigma \frac{P}{d}$; Σ is the sign of a sum.

Experimentally, 500 grains of the glass under test, whose diameters are confined between 1.0 and 1.4 mm., are spread on a steel plate (diameter: 90 mm.) and hit by a hammer of 2 kg. falling from the height of 30 cm. The crushed glass is collected and passed through sieves to obtain 7 fractions. The value of d is given by the size of the sieve openings and requires no additional measurements.

A FORMULA FOR COMPARING GLASS FURNACES

Sometimes it is difficult to decide which of two or several glass furnaces has the best performance because each furnace may have its particular advantages and shortcomings. I. I. Ben proposes a formula for estimating the over-all performance of a furnace; see *Steklo i Keramika* (Glass and Ceramics) **10**, No. 2, p. 24 (1953).

This formula is $P = \frac{AC}{A + B}$ (1.1 D_1 + D_2 + 0.8 D_3 + 0.55 D_4). P is the over-all performance. A is the duration of work of the furnace from the end of a major repair to the start of the next major repair. B is the duration of the time lost on repairs, including one major repair. C is the amount of marketable glass obtained in 24 hours from 1 sq. meter of the furnace area. D_1 is the fraction of the marketable glass having the highest quality. D_2 is the analogous fraction for second quality glass. D_3 same for third, and D_4 same for the lowest quality. The coefficients are 1.1, 1.0, 0.8 and 0.55 because the Russian prices for the four qualities of glass are in the ratio 1.1:1.0:0.8:0.55.

If P_1 is the performance of one, and P_2 that of another furnace, the ratio $P_1 : P_2$ does not yet give a final estimate of the comparative value of the two furnaces because it leaves out the operating expenses. If the operating expenses (including fuel and repairs) are e_1 and e_2 for the two furnaces, the ratio $\frac{P_1 e_2}{P_2 e_1}$ is this estimate.

• Dr. Alexander Silverman gave an illustrated talk on "Glass Evolution: A Factor in Science" at the recent meeting of the Division of the History of Chemistry of the American Chemical Society.

• The Ohio Hydrate and Supply Company has announced that its company name has been changed to Ohio Lime Company. The company is located in Woodville, Ohio.

Inventions and Inventors

Annealing and Tempering

Process for Shaping Glass Articles. Patent No. 2,674,067. Filed September 16, 1949. Issued April 6, 1954. No drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chemiques de Saint-Gobain by Giulio Reggiani.

When two samples of the same glass are shaped under the same conditions, one of them having previously been annealed and the other tempered, the last one because of its lower viscosity will be shaped more easily and at a lower temperature than the annealed sample. The ultimate conformation may be obtained by means of successive partial operations, the special thermal treatments consisting in a sudden cooling of the heated article being repeated before each of the various phases of the conformation of the piece of glass. Instead of submitting the whole glass mass to the previous altering treatment of the viscosity, it may be advantageous to alter the viscosity of a portion only of the glass mass, the shape of the glass mass being subsequently modified. The process permits a shaping of hard glass articles by heating such articles to a lower temperature than would be necessary had they been previously annealed. After conformation or shaping, the sheet may be submitted to thermal treatment, as annealing or tempering.

The patent contains 5 claims and the following references were cited: 1,301,714, Kueppers, Apr. 22, 1919; 2,233,435, Snow, Mar. 4, 1941; 2,250,628, Forbes, July 29, 1941; 2,348,279, Boyles, et al., May 9, 1944; 2,377,849, Binkert, et al., June 12, 1945; 111,753, Australia, Oct. 16, 1940; and 620,535, Great Britain, Mar. 25, 1949.

Feeding and Forming

Article Feeding Device. Patent No. 2,675,647. Filed February 10, 1949. Issued April 20, 1954. Two sheets of drawings (none reproduced). Assigned to Sylvania Electric Products Inc. by Henry W. Roeber.

This invention relates to article feeding devices and more particularly to a device for axially feeding short tubular glass work pieces from a reservoir to a mold where further work operations are performed on the glass section. The machine is particularly adapted to sealing metal leads transversely through a molded glass button to form a header for radio tubes and like devices. It includes a turret carrying a plurality of spindles, each spindle including upper and lower mold cavities, both cavities having bores for receiving metal leads which are to be sealed into the molded glass.

In the operation of the machine, at least some of the metal leads are placed into the bores in the mold cavities and a short length of glass tubing is set into the lower mold cavity around the metal leads. Thereafter flames are directed toward the glass tubing until it softens sufficiently so that when the upper mold cavity is pressed down against the lower mold cavity, the glass tubing is molded into a solid glass button having the leads extending there-through.

The patent contains 5 claims and 10 references.

Glass Compositions

Glass Batch and Article Therefrom. Patent No. 2,673,808. Filed December 18, 1950. Issued March 30, 1954. No drawings. Max Meth.

The principal object of the invention is the manufacture of an aerated glass which will have excellent heat insulating properties. The glass constituting this invention is composed by weight of one hundred parts of sand, one hundred parts of sodium carbonate, one hundred parts of feldspar, and coloring matter, if desired.

A batch so constituted will become molten at a temperature around 2600°F. and may be worked at temperatures around 2100°F. As the glass is progressively withdrawn from the furnace, additional amounts of batch are added to the top of the mass so that continuous operation is obtained. A great multiplicity of bubbles will form in the mass, the vast majority of which will range in size from 1/16″ to ¼″ in diameter. The bubbles will occur in such profusion that the amount of glass separating them will be quite thin. It is claimed that glass made according to this invention retains all of the strength of ordinary lime glass and has the further property of providing, for molded or rolled articles, a smooth, unbroken exterior skin or surface which encloses the mass of voids or bubbles.

The patent contains 10 claims and the following references were cited: 1,332,058, Musial, Feb. 24, 1920; 2,224,493, Taylor, Dec. 10, 1940; 2,237,037, Lytle, Apr. 1, 1941; 2,255,236, Willis, Sept. 9, 1941; 2,306,310, Haux, Dec. 22, 1942; 2,322,581, Lytle, June 22, 1943; 2,544,954, Ford, Mar. 13, 1951; and 404,442, Germany, 1924.

Process for Forming Optical Glass by Melting in Platinum Vessels. Patent No. 2,673,809. Filed July 3, 1951. Issued March 30, 1954. No drawings. Assigned to Ernst Leitz G. m. b. H. by Gustav Weissenberg and Otto Ungemach.

In order to melt optical glass with the greatest possible homogeneity and freedom from striae and bubbles, efforts have recently been made to carry through the entire melting in platinum vessels. An addition of from ¼% to 10% by weight of tellurium oxide, TeO_2 or TeO_3, to the fused mass of the glass is sufficient to attain generally that the melt does not adhere to the platinum vessels. Moreover, through a gradual addition of tellurium oxide, an extraordinary thinning of the melt is obtained so that the blending is much easier than was formerly possible. Instead of TeO_2, the six valence oxide of tellurium TeO_3 can be used, which is apparently reduced in the melt to TeO_2. A higher addition to the melt of TeO_2 or TeO_3 than 1% generally causes a strong increase in the index of refraction which is combined with an increase in dispersion. Alloying or injury of the platinum vessel has not been found after several months research with tellurium oxide.

The patent contains 4 claims and the following references were cited: 2,411,031, Deyrup, Nov. 12, 1946;

2,444,845, Perley, July 6, 1948; 2,497,235, Perley, Feb. 14, 1950; and THE GLASS INDUSTRY, vol. 13, No. 8, August 1932, page 133.

Glass Wool and Fiber

Cleaning Glass Cloth for Laminations. Patent No. 2,674,549. Filed May 28, 1951. Issued April 6, 1954. Three sheets of drawings (none reproduced). Assigned to Glass Fibers, Inc. by Emil H. Balz.

Present known methods for the removal of the binder from glass cloth require the treatment of the cloth at temperatures of the order of 600 to 700°F. for prolonged periods, generally 55 to 60 hours. Such methods seriously hinder production, require an excessive amount of equipment for a given production and are exceedingly expensive.

This invention provides a novel method for the removal of the binder material from the glass cloth utilizing a short moderate heat cycle. This is done in order that the glass cloth can be laminated with synthetic resins. The glass cloth is first treated with a strong chlorate solution such as the chlorates of sodium, potassium, calcium, barium or strontium. About 3 to 10% by weight of chlorate, at a temperature of about 150°F., is used. Detergents or wetting agents, such as Triton N-100, are employed in the chlorate solution to assist in the penetration and wetting of the cloth. Heating at moderate temperatures of 650°F. to 750°F. is used to burn the binder from the treated glass cloth and the time of exposure to the heat need only be very short; that is, in the range of about ½ to 1½ minutes. The cleaned glass cloth thus produced will laminate readily with silicone resin and when the cleaned cloth is first treated with a cationic agent, such as Volan, a bond with the polyesters may be effected.

The patent contains 14 claims and the following references were cited: 1,540,491, Milliken, June 2, 1925 and 1,578,933, Smith, Mar. 30, 1926.

Sized Strands and Method of Making Same. Patent No. 2,671,744. Filed February 9, 1951. Issued March 9, 1954. No drawings. Assigned to Owens-Corning Fiberglas Corporation by L. P. Biefeld and J. P. Stalego.

This invention relates to the treatment of glass fibers in the manufacture of strands, yarns and the like. It is desired to produce glass fibers in strand or yarn form sized with a composition which imparts a desired balance of lubricity and adhesion, toughness and abrasion resistance, as well as a base for permanent coloring of the glass fibers.

The desired characteristics are achieved by the use of a polyamide resin compounded by the reaction of a dimerized or trimerized fatty acid of 10 to 20 carbon length, such as linoleic acid and linolenic acid with a polyamine, preferably a diamine such as ethylene diamine.

The treating composition may be applied as a size to the glass fiber surfaces from solvent solution employing alcohols, such as propyl alcohol. Acetone and other ketones and esters, such as butyl cellosolve, ethyl acetate and the like, may be used as the solvent medium, as well as chlorinated solvents such as methyl chloride, ethylene dichloride and the like. Solvent solution, concentrations ranging from 2 to 20 per cent by weight solids, may be employed as the treating composition.

Glass fiber braid dipped 15 times in the above composition and followed by a short air dry after each dip, and then a final bake at about 150°F. for 5 minutes, has an abrasion resistance that withstands 335 strokes of a standard abrasion tester.

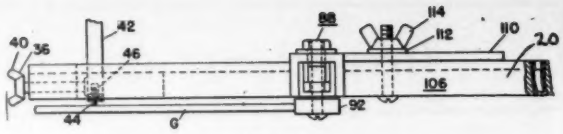


Fig. 1.

The patent contains 4 claims and the following references were cited: 2,359,877, Schupp, Oct. 10, 1944; Cowan: *Oil and Soap*, vol. 21, April 1944, pages 101-107; and *Modern Polyamide Resins*, A. G. Hovey, May 1945, pp. 125, 126, 192.

Sheet and Plate Glass

Device for Cutting Glass. Fig. 1. Patent No. 2,674,043. Filed April 20, 1953. Issued April 6, 1954. One sheet of drawings. Assigned to Stott-Hecht Glass Works by Harold A. Perilstein and Harry Wandel.

An object of the present invention is to provide apparatus for producing an accurate score line on a sheet of flat glass or the like. When the wing-nut 114, shown in Fig. 1, is loosened, the guide-member 110 is free to move longitudinally along the body and can be manually adjusted to position the cutter any desired distance inward of the free edge of the sheet of glass G, after which the wing-nut is tightened to lock the guide-member securely to the body.

The device is then positioned against the sheet of glass to be cut, so that the rollers 60 (not shown), 92, 92, bear firmly against the edge of the glass, while the wheel 44 of the cutter 42 rests upon the top surface of the glass, with the axis of the wheel parallel to the axis of the body 20.

By simply loosening and retightening the wing-nut 114, the glass worker or glazier can adjust the device to cut sheets of glass into different size smaller sheets or panes having absolutely parallel sides so long as he has an original straight edge to work from. When the cutting wheel becomes worn or dull, the cutter can be quickly and easily replaced by simply loosening the clamping member 36.

The patent contains 5 claims and the following references were cited: 1,195,886, Wheeler, Aug. 22, 1916; 1,788,175, Strobel, Jan. 6, 1931; 1,792,393, Phillips, Feb. 10, 1931; 2,354,539, Passick, et al., July 25, 1944; and 2,591,999, Barham, Apr. 8, 1952.

Method and Apparatus for Surfacing Glass. Fig. 2. Patent No. 2,673,423. Filed March 14, 1951. Issued March 30, 1954. Eleven sheets of drawings. Assigned to Pittsburgh Plate Glass Company by Eugene Hoyet and Frank F. Painter.

This invention relates to apparatus for the simultaneous grinding and polishing of opposite sides of a continuous ribbon of glass passed through the apparatus in a horizontal position. The apparatus as illustrated is specifically adapted for polishing glass, but the same principles of operation of the apparatus are adaptable to all or some of the grinding operations performed on the glass preparatory to polishing.

In order to reduce the length of the polishing appara-

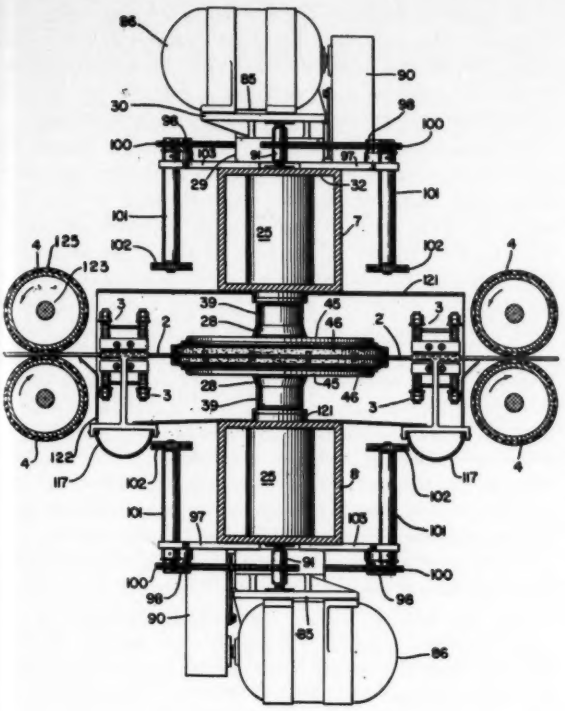


Fig. 2.

tus, it is proposed to use greatly increased pressures of the polishing felts. The apparatus is adapted for use with 20 to 40 ounces or more of diaphragm pressure per square inch when the glass is supported in the manner described. The glass is floated in substantially a single horizontal plane, while moving between the rotating polishing felts of opposing spindles, by means of fluid pressure acting upon the felts independently of the mass of the opposing driving spindles.

In order to control the amount of heat generated beneath each felt 46, the rouge feed valves are individually and automatically actuated to feed rouge to each felt whenever the friction resistance between any felt and the glass reaches a pre-selected maximum.

As the glass 2 moves out from under the felts 46 of the first bridge 1, it passes through the cooling unit 3 which washes the glass and dries it before passing between rolls 4. Upon leaving driving rolls 4, the glass then passes through a second cooling unit 3 before entering the second bridge 1, where the polishing action is repeated. Enough polishing bridges 1 are provided to effect the degree of polishing desired. Where a plurality of pairs of rotating opposed felts are disposed transversely of the glass, the same polishing action, rouge feed and heat control occurs at each pair of felts. Tests have shown that with apparatus of the type illustrated, a temperature differential of less than 5°F. can be maintained transversely of the glass sheet.

The patent contains 18 claims and 10 references were cited.

Apparatus for Surfacing Glass Sheets. Fig. 3. Patent No. 2,673,424. Filed December 4, 1951. Issued March 30, 1954. Three sheets of drawings. Assigned to Les Glaceries De La Sambre, Societe Anonyme by Edmond Laverdisse.

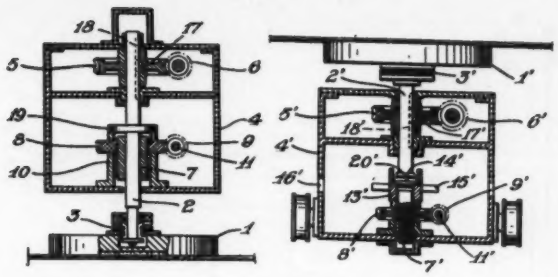


Fig. 3.

This invention relates to the mounting of tools for grinding glass or glass grinding discs and tools for polishing glass or glass polishers. It relates more particularly to machines in which these tools are carried by beams arranged above and below the glass sheet in order to act successively on both sides thereof, or arranged in pairs to act simultaneously on both sides of the glass. It is important that the tools be correctly applied on the surface of the glass and, consequently, that their working faces be located exactly at the same level and parallel to the glass sheet in order to avoid localization of undue stresses.

The working tool 1 in Fig. 3 is mounted on a vertical shaft 2 with interposition of a ring or rubber or other elastic material 3, permitting of a slight angular movement of the tool relatively to the horizontal in order to apply the surface of the tool 1 exactly on the surface of the glass sheet. The shaft 2 mounted in the beam 4 is rotated during the operation of the machine by a helical wheel 5 driven by a worm 6, the wheel 5 being fitted with a key 17 slidably engaging a groove 18 in the shaft 2, thereby permitting vertical movement of the shaft 2 in the wheel 5. The shaft 2 is rigidly connected with a collar 19 and is adapted to slide in a threaded sleeve 7.

Each lower tool 1′ is also mounted on its shaft 2′ by means of an elastic ring 3′. The shaft 2′ is supported in the lower beam 4′ so that it can be adjusted vertically both individually and together with the other shafts 2′. The invention thus permits a suitable adjustment to keep the tools applied against both sides of the glass with equal pressures.

The patent contains six claims and the following references were cited: 1,474,672, Heuze, Nov. 20, 1923; 1,782,475, Merian et al., Nov. 25, 1930; 1,833,359, Fox et al., Nov. 24, 1931; 2,273,624, Campbell et al., Feb. 17, 1942; 2,341,524, Bezborodko et al., Feb. 15, 1944; 2,402,293, Nye, June 18, 1946; and 2,419,926, Waldron, Apr. 29, 1947.

Apparatus for Grinding Flat Glass on Both Faces Simultaneously. Fig. 4. Patent No. 2,673,428. Filed July 18, 1951. Issued March 30, 1954. One sheet of drawings. Assigned to Pilkington Brothers Limited by Thomas S. Cook.

This invention relates to methods of and apparatus for grinding a moving horizontal ribbon of flat glass on both faces simultaneously. It is concerned with a method and means for preventing the suction effect, which may develop in certain circumstances in the central cavity of lower grinding discs as described in Patent No. 2,577,889.

In Fig. 4 a lower grinding disc 1 is shown. It is substantially 27½ inches in radial width and mounted on

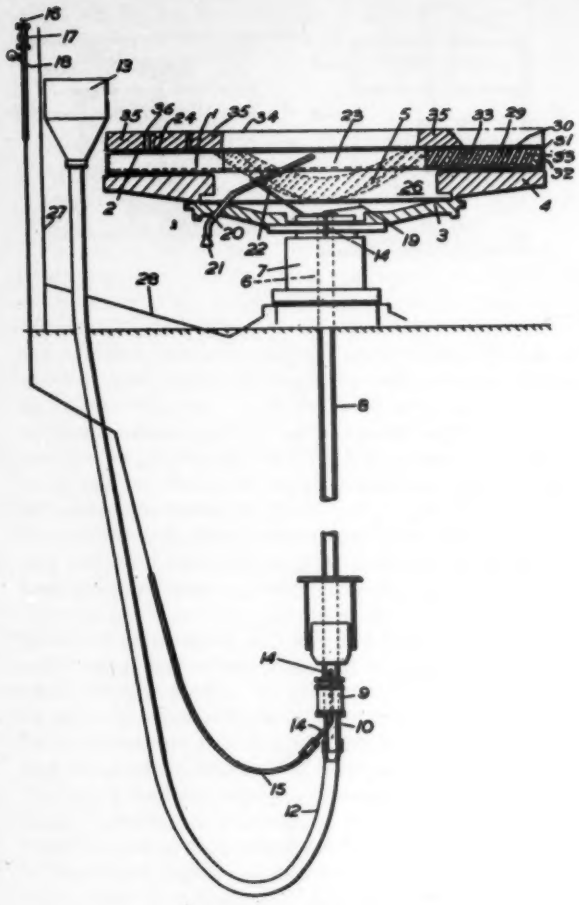


Fig. 4.

the flange 3 of a tool by means of an annular casting 4, which with the tool and disc forms a central cavity 26 to which liquid 5 carrying abrasive is fed upwardly through a central bore 6 in the driving shaft 7.

In operating the glass grinding tool, liquid carrying abrasive, for example sand, is fed to the central cavity of the grinding disc 2 by way of conduit 8 and a corresponding upper grinding disc (not shown) is similarly supplied. Air is admitted to the pipe 14 of the lower tool and the choke on vent pipe 20 is adjusted to maintain the pressure of ½ inch of water in the upper part 23 of the central cavity 26. The ribbon of glass 24 is thus uniformly and resiliently supported over the central cavity by the air pressure. Thus by this means a ribbon of glass being ground with large grinding tools may be uniformly supported over the whole of the central cavity area on a fluid support.

The patent contains 3 claims and the following references were cited: 696,195, Rogers, Mar. 25, 1902; 1,075,515, Steingasser, Oct. 14, 1913; 2,010,405, MacIsaac, Aug. 6, 1935; 2,041,642, Griffin, May 19, 1936; and 526,919, Great Britain, Sept. 27, 1940.

Continuous Sheet Glass Drawings and Coating Apparatus. Fig. 5. Patent No. 2,675,646. Filed October 22, 1952. Issued April 20, 1954. Three sheets of drawings. Assigned to Adamston Flat Glass Company by W. M. Kramer and H. J. Marsh.

In order to improve the durability of sheet glass, an apparatus is provided for continuously drawing the glass and at the same time coating the surface of the sheet with a polysiloxane film as the glass passes through an atmosphere containing an organosilicon solution.

A transverse section of the apparatus is shown in Fig. 5. A continuous glass sheet 3 is drawn upwardly from this mass of molten glass through a drawing block 4. This sheet of drawn glass 3 passes upwardly through an opening in the base of the roller and coating housing 5. The sheet of glass passing upwardly through the apparatus moves between pairs of spaced rollers 6, 7 and 8. By the time the glass sheet 3 has passed the pair of rollers 7 located below the coating housing 9, the once molten glass has cooled to a point where it is set up and no longer is in a molten or plastic state. Preferably, the temperature of this glass as it enters the opening between the halves of the coating chamber is between 100°F. and 400°F. The heat remaining within the sheet glass as it passes through the coating chamber causes the coating solution within the atmosphere of the chamber to form a polysiloxane film on the surface of the sheet glass.

The atmosphere within the coating chamber 9 is created by the sprayers 23, which aspirate the coating solution from the supply chamber 30 and spray it into the respective housings 9a and 9b. The solution preferably contains about 0.02 to about 2.0% by weight of an organosilicon compound in a chlorinated hydrocarbon solvent. After moving through the coating chamber 9, the drawn glass sheet continues upwardly through the remaining pairs of drawing rollers shown at 8. The glass sheet thus becomes finally cooled and is in condition then to be cut up into lights.

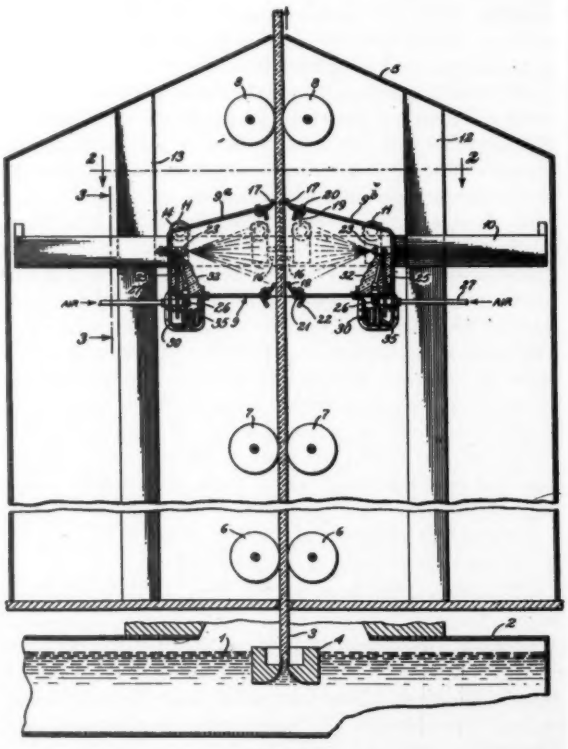


Fig. 5.

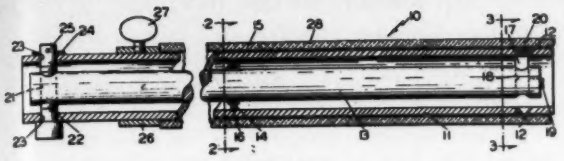


Fig. 6.

The patent is a continuation of Patent No. 2,630,656. It contains 4 claims and the following references were cited: 2,068,746, Hinsey, Jan. 26, 1937; 2,235,978, Braucher, Mar. 25, 1941; 2,428,307, Carlton, Sept. 30, 1947; 2,491,889, Beunett et al., Dec. 20, 1949; and 595,452, Germany, Apr. 11, 1934.

Tube and Cane Machines

Apparatus for Cutting Glass Tubing. Fig. 6. Patent No. 2,674,066. Filed June 20, 1951. Issued April 6, 1954. One sheet of drawings. Assigned to International Harvester Company by Holger Pedersen.

This invention relates to an improved apparatus for cutting glass tubing into lengths. The improved device provides cut sections that are free from burrs and are left clean with square edges.

In referring to Fig. 6, the glass tube 28 is slid over the tubular support 13 until it engages the stop collar 26. At this point the cutting wheel 20 may be retracted into the tubular support 13 and the tubing can be easily and readily slid over the tubular support without interference. After the glass tube 28 is in place, the adjusting screw 22 is turned so that the rod 13 pivots on the pivot point 16. The cutter support 17 is thus moved through the opening 12 and the cutting wheel 20 is moved into engagement with the inner surface of the glass tube. The rod 13, because of its length and manner of positioning, acts as a spring urging the cutting wheel 20 into cutting engagement with the inner surface of the tube. The glass tube 28 is then rotated on the tubular support and the cutting wheel scores the inner surface of the tube. By virtue of the novel arrangement shown, the cutting wheel 20 may be accurately adjusted relative to the glass surface, the engagement of the cutting wheel being so slight that only a very shallow and tiny annular fissure is formed in the glass tube. The tubing thus scored can be subjected to a heating and cooling operation, whereupon the tubing can readily be snapped in two, leaving square and clearly cut edges at the beveled ends.

The patent contains one claim and the following references were cited: 365,190, Lindgren, June 21, 1887; 672,312, Cook, Apr. 16, 1901; 818,213, Amos et al., Apr. 17, 1906; 2,116,129, Stringer, May 3, 1938; 2,125,-864, Auckland, Aug. 9, 1938; and 2,125,922, Hopfield, Aug. 9, 1938.

Dummy Feed for Stem Machines. Patent No. 2,672, 712. Filed August 8, 1947. Issued March 23, 1954. Three sheets of drawings (none reproduced). Assigned to Sylvania Electric Products Inc. by W. L. Reiter.

The present invention relates to molding machines for forming vacuum-tube stems or headers. A mold is moved step by step through a sequence of loading, heating, forming and ejecting positions, so that various metal inserts and glass stock may be automatically placed in the mold. The glass is fused and shaped, and the molded product finally removed from the machine. Inserts are automatically supplied to ducts which direct them into recesses in the mold. To achieve this purpose a high velocity air jet is directed externally along the duct toward the mold so as to develop a partial vacuum in the end of the duct nearest the mold, thereby drawing an air stream and with it the metal insert toward the mold and an insert-receiving recess therein. As a further aid in reliable feeding, the duct is reciprocated into contact with the mold for connecting the duct to the insert-receiving recess. Lateral passages in the end of the duct sustain the air streams until the latest possible instant.

The patent contains 12 claims and the following references were cited: 2,405,074, Underwood, July 30, 1946 and 2,411,660, Manning, Nov. 26, 1946.

Miscellaneous Processes

Grinding Ophthalmic Lenses. Fig. 7. Patent No. 2,674,068. Filed August 20, 1949. Issued April 6, 1954. Four sheets of drawings. Assigned to American Optical Company by Joseph R. Eves and Oscar W. Lundstrom.

When a lens 73 is positioned, as shown in Fig. 7, with an edge portion in engagement with the V-groove 27 for abrading, the abrading wheel 16 is rotated about its axis. This action causes the lens to be abraded by the wheel in accordance with the shape of a pattern 75 fixedly carried by the outer end of the lens supporting shaft 55. The pattern 75 is rotatable with the lens 73 and is shaped in accordance with the desired shape of the resultant lens.

When the pattern 75 engages the shoe 78 with sufficient force, as resulted when that portion of the lens engaging the abrading wheel has been ground to finished depth, this causes the contacts 83 and 84 to become engaged. This will close the circuit and energize the motor 54 to cause the lens to be rotated sufficiently to present the next adjacent edge portion to be beveled by the V-groove 27 of the abrading wheel 16. This portion, prior to receiving its bevel, will cause the pattern to be moved in a direction away from the shoe 78 and thereby release the engagement of contacts 83 and 84 breaking the circuit to the motor 54, which will not be operated again until the newly presented unbeveled edge portion of the lens has been abraded to the desired depth. This operation is progressively and automatically repeated until the entire edge is beveled.

The patent contains 10 claims and 24 references were cited.

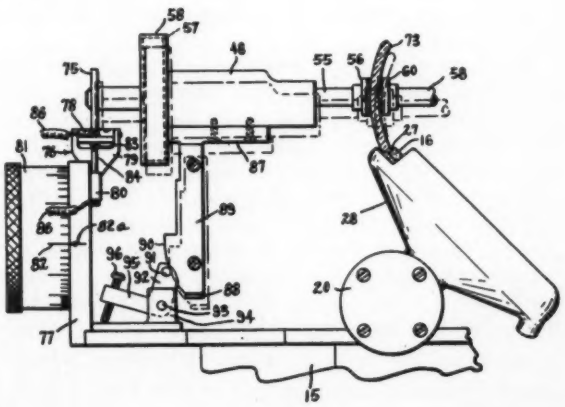


Fig. 7.

R. R. Shively | V. H. Remington | Ray Andrews

EXECUTIVE CHANGES AT DRAKENFELD

Announcement has been made by B. F. Drakenfeld & Company of the retirement of Dr. Robert R. Shively as Vice President. Dr. Shively, who has served with the company for 32 years, will continue as a Director.

Named to succeed Dr. Shively, is Victor H. Remington, who has served for a number of years as Manager of the company's Glass Color Division. Mr. Remington will be succeeded by Ray Andrews.

Dr. Shively has a long list of accomplishments in the glass and ceramic fields, dating back to 1913 when he developed a highly efficient illuminating glass which is still in use. Among the first to use selenium as a decolorizer and to make pink glass in a continuous tank, he is believed to have made the first selenium amber produced in America. He also contributed technology essential to produce cerium yellows in continuous tanks. After joining Drakenfeld in 1922 as chief technologist, he inaugurated the policy of providing color research service for customers. Dr. Shively was also active in introducing the tenchnique of producing various colored glasses in pots and tanks and was the first in America to use neodymium in making a commercial neodymium glass for art pieces and tableware.

Victor Remington, a graduate of Baker University in 1916, was the recipient of a graduate Fellowship at Oklahoma A & M and in 1928 received his M.S. degree in chemistry. Joining the Drakenfeld organization immediately upon graduation, he entered into research and development work on glass colors. Mr. Remington is the author of numerous articles which have appeared in glass and ceramic journals, was a contributor author to the recently published HANDBOOK OF GLASS MANUFACTURE and has co-authored patents on ceramic color and process of preparing the same, vitreous enamel and coloring material.

Mr. Andrews was first employed as an analyst by the Hazel-Atlas Glass Company and later joined the staff of the Combustion Utilities Corporation as a gas and coal analyst. In 1930, he joined the United States Bureau of Mines as a scientific aide in the Organic Research Laboratory of the Pittsburgh Station. In 1933 he was employed by the Drakenfeld organization. Since that time he has moved through all phases of the company's business, including color matching, research, product development, sales, service and management. He has also authored several patents jointly and alone. Named

• The Cincinnati District Office of Bailey Meter Company has moved to larger quarters at 2330 Victory Parkway, Cincinnati 6, Ohio.

G.C.M.I. MOVES OFFICES

The Glass Container Manufacturers Institute has moved to new offices at 99 Park Avenue, according to Victor L. Hall, General Manager. Branch offices are also maintained in Washington and San Francisco.

The Institute's new quarters comprise 7,600 square feet on the fifth floor of the new 26-story aluminum-faced building on the East Side of Park Avenue between 39th and 40th Streets. Principal reason for the move, Mr. Hall stated, was the need for larger quarters to accommodate staff additions made during the past year.

ANNUAL MEETING OF SOCIETY OF RHEOLOGY

The Society of Rheology will hold its 1954 Annual Meeting in Washington, D. C., on November 3, 4 and 5. The technical sessions will be held at the National Bureau of Standards and headquarters will be at the Sheraton Park Hotel.

The following four main groups of papers are scheduled: (1) time dependent mechanical behavior of monomeric liquids, elastomers, plastics, glass and asphalts, (2) statistical and molecular theories of liquids with particular regard to rheological processes, (3) volumetric strain in monomeric liquids, glass and organic polymers, and (4) critical velocities and impact strength, anisotropy and chemically induced relaxation of fibers.

PANGBORN CELEBRATES 50TH ANNIVERSARY

Pangborn Corporation celebrated its 50th year of operation on September 1 and 2 with a special program of events.

On September 1, the company held an Open House to which the public was invited. Tours were made throughout all departments, with work proceeding as usual. Later, all Pangborn employees and visitors gathered on the lawn in front of the main office building where an employee of the company officially unveiled a tribute to Thomas W. Pangborn and his brother, John C. Pangborn, founders of the corporation, as a gift from all employees. September 2 featured an Employees' Night and a special program of entertainment was arranged and presented.

GLASS FIBERS ESTABLISHES WESTERN DIVISION

The establishment of the Western Division of Glass Fibers, Inc., with full responsibility for administrative, manufacturing and sales activities in 11 western states, has been announced by R. H. Barnard, President.

M. Dean Worcester, Vice President of the company, has been appointed General Manager of this new Western Division with headquarters in Burbank, California. Mr. Worcester was formerly General Manager of the firm's Burbank Division which now becomes a part of the larger divisional operations. John T. Podorean has been advanced to General Sales Manager of the Western Division.

• Francisco Acosta Ramis, comptroller of Ferre Enterprises, Ponce, has been elected Vice President of the Puerto Rico Control of the Controllers Institute of America.

Research Digest

Assessment of the Efficiency of Glass Tank Furnaces

In the June 1954 issue of the *Proceedings of the International Commission on Glass,* W. M. Hampton points out that in a discussion on methods of assessing the efficiency of tank furnaces, the furnace performance formula proposed by the Society of Glass Technology has been discussed critically in various parts of the world and its general applicability remains unchanged. (Editor's Note: For example: refer to the paper entitled "Evaluating the Performance of Continuous Glass Melting Tank Furnaces" by D. E. Sharp and L. B. Ginther, THE GLASS INDUSTRY, May 1954.) There is some natural resentment by those who find the application of the formula gives a poor Q value for their own furnaces, and the tendency is to say that the formula cannot be correct because the furnace concerned is known to be a good one. From this, of course, the question arises as to what is meant by a good furnace. It usually appears that it is a furnace which either produces glass of satisfactory quality, or which is very profitable, or that some similar criterion is being used.

The only basis of assessment now under discussion is that of thermal efficiency. It is realized that thermal efficiency is not necessarily related to money-making, or even to the production of glass of high quality, but it is the only scientific criterion which can be discussed here.

Therefore, a good furnace is one which is thermally efficient, and it can be demonstrated readily that a furnace which is thermally efficient also has a low Q value.

In order to determine thermal efficiency, it is obvious that some figure must be found which is independent of the operating conditions imposed by commercial requirements. The heat used in a furnace is utilized in two main directions: (1) to maintain the furnace and structure at the appropriate temperature and (2) to transfer heat into the glass and to melt it from the raw materials.

The Furnace Committee of the Society of Glass Technology accepted as a numerical measure of efficiency the quantity of heat needed to maintain unit area of a furnace at a predetermined temperature and they considered that a furnace which achieves this with the lowest heat consumption is the most efficient from the thermal point of view. Such a figure can only be determined precisely by the production of a complete thermal balance. This is expensive in time, money and staff, and also calls for every skillful experimentation in order to obtain a satisfactory result. It usually occupies several days and it is obviously not a method which can be adopted for routine purposes. The furnace performance formula was designed to give an approximate result using data normally available in a glassworks. These are the size of the furnace, the temperature of operation, the glass output and the fuel consumption, characteristics known to varying degrees of precision. The size of the furnace is known accurately. The measurement of furnace temperature is, in a strict sense, difficult. On the other hand, it is well-known in any glassworks that a furnace is operated at a specific, known temperature and it can be shown theoretically that the corrections necessary to allow for deviations from any predetermined temperature are relatively small. It is necessary only to assume that the furnace is operated at, say, 1450 or 1500°C. or a similar appropriate, approximate value which is a sufficiently accurate estimate. The glass output varies from hour to hour and from day to day, but commercial requirements of cost insure that fairly accurate values are available. The fuel consumption is usually the least accurate of those obtained.

Using these values in the furnace performance formula, it is possible to determine the Q value daily or weekly, i.e., the quantity of heat required per second to maintain unit area of glass at a standard temperature of 1400°C. This value can then be recorded or graphed to indicate the thermal efficiency of the furnace. From this point of view, the absolute accuracy of the Q value is unimportant. Suggestions have been made that allowances should be introduced into the calculation for the type of glass, for the color of the glass and for the age of the furnace, but the influence of these factors will only be appreciated if the Q values are recorded and graphed as suggested. While it has been known vaguely that an old furnace consumes more fuel than a new one, the very idea of "ageing factor" as a precise function of time within the life of a furnace only becomes obvious when Q values are calculated and used in this way. It is generally agreed that the formula can be used satisfactorily to ascertain the variations from week to week in the performance of a furnace throughout its life. Most of the criticisms of the formula arise when it is desired to compare furnaces of different kinds of glass.

It must be admitted that the area correction factor, as given in the original report, is capable of improvement, but the fundamental principle remains that a large tank furnace has a smaller radiation surface relative to the area of glass than a small one. An approximation to this correction factor is given in the report and, clearly, for two furnaces geometrically similar but of different sizes, the same Q value should be obtained for each. This is justified since if a small furnace is inherently less efficient than a large one, this should be recognized in the formula. Expressed otherwise, by means of the Q values, one attempts to ascertain if the smaller furnace is as efficient for its size or the larger one for its size. If differences occur, these can probably be traced to differences of shape, depth, height of superstructure and so on, factors which are not taken into consideration by the formula. The very fact that these can affect the Q value is a justification for the use of the formula. The differences between Q values emphasize the effect of modifications of design for if a higher Q value is obtained, a lower thermal efficiency is implied. The same difference would also be apparent if a heat balance were determined for the two furnaces concerned. The Q value, of course, depends not only on furnace design, but also on oper-

(*Continued on page* 518)

AMERICAN WINDOW GLASS ELECTS DIRECTOR

A. S. Crandon, President of American Window Glass Company, has announced the election of Norman B. Thirion as a Director of the company and Vice President in charge of Sales.

Mr. Thirion has spent his entire career in the flat glass industry and formerly was a partner of Frank Thirion and Son, Danville, Illinois. His family has been associated with glass for seventeen generations.

Mr. Thirion, who assumed his new duties on September 1, will direct the sales program for Lustraglass, Supratest safety glass, American translucent structural Panal and other products manufactured by American Window Glass and its subsidiaries.

PATENT ADVISOR NAMED

Arthur Vinograd, formerly a patent examiner with the U.S. Patent Office and a member of the Bar of the Supreme Court, has been appointed Patent Advisor at the National Bureau of Standards.

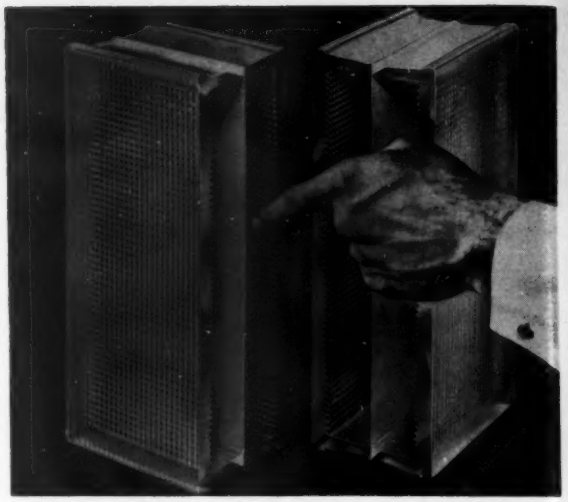
Mr. Vinograd is responsible for drawing up and filing patents on all inventions made at the Bureau. In this capacity, he must be familiar with a wide variety of scientific fields. He holds a B.S. and an M.E. degree from the School of Technology, College of the City of New York, and an LL.B. degree from the Law School of George Washington University. He is a member of the Patent Office Bar, The Bar of the U. S. Court of Customs and Patent Appeals, the District of Columbia Bar, the Court of Appeals of the District of Columbia, and was recently admitted to practice before the Supreme Court of the United States. He has served for 12 years as an Examiner of Computers in the Patent Office receiving a meritorious award for his work.

ACHESON ADOPTS NEW TRADEMARK

Acheson Industries, Inc. has introduced a new trademark as a common denominator for four affiliated manufacturing companies. The central figure of this new trademark is a large hexagonalized "A" surrounded by an hexagonal border. The name Acheson stretches across the bar of the "A", while the phrase "Unit of Acheson Industries" is spaced along the periphery of the hexagon when used by a subsidiary or division.

The trademark derives its hexagonal form from the shape of the graphite crystal, and is significant because it pays tribute to the late Dr. Edward Goodrich Acheson, founder of the parent company.

• Fred E. Fuller, General Counsel for Owens-Illinois Glass Company and senior partner in the law firm, Fuller, Harrington, Seney and Henry, has been elected Vice Chairman of the Anti-Trust Section of the American Bar Association. Mr. Fuller has been a member of the Governing Council of the Anti-Trust Section since its formation three years ago.



Cross-section of a typical Pittsburgh Corning functional glass block shows the light controlling prisms on the inner surfaces and the fibrous glass screen which reduces heat transmission and excessive brightness.

PITTSBURGH CORNING INTRODUCES NEW GLASS BLOCKS

Pittsburgh Corning Corporation has announced a new series of glass blocks that reduce glare and solar heat gain. Known as "Suntrol", these blocks are expressly designed to meet the requirements of architects who are faced with high brightness problems resulting from sun and snow. They contain a pale green fibrous glass diffusing screen that reduces surface brightness or glare by 35 per cent and instantaneous heat gain by 25 per cent.

Suntrol blocks are available in three different 12-inch functional patterns including a special toplighting block for use in skylights. They are available in a light-directing pattern that throws light upward toward the ceiling, a light-diffusing pattern that diffuses light in all directions and "Skytrol" toplighting glass blocks that distribute light over wide floor areas.

WESTVACO APPOINTMENTS

Donald C. Oskin has been appointed Manager of Sales and James R. Harris, Assistant Manager of Sales, of Westvaco Mineral Products Division, Food Machinery & Chemical Corporation, it has been announced.

Also announced was the appointment of Arthur F. Smith as Manager of Sales and Preston F. Tinsley, Assistant Manager of Sales, of the Westvaco Chlor-Alkali Division.

INTERNATIONAL MINERALS ACQUIRES REFRACTORIES COMPANY

The International Minerals & Chemical Corporation has acquired Sonsel Refractories Corporation at Brighton, Michigan, it has been announced by Louis Ware, President of International.

The newly acquired plant will continue production of zirconium refractories under a patented process and other special refractories on an expanded scale as part of the Eastern Clay Products Department of International's Industrial Minerals Division. It has been announced that there will be no changes in plant management or personnel.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during June 1954 was as follows: *Flat Glass:* A preliminary 25,300 persons were reported during June. This is 2.4 per cent higher that the adjusted 24,700 reported for May. *Glass and Glassware, Pressed and Blown:* 77,300 persons were employed during June according to preliminary reports. When compared with the previous month's adjusted 77,900, a drop of .7 per cent is shown. *Glass Products Made of Purchased Glass:* Preliminary reports show that 13,200 persons were employed during June. This is .7 per cent below the 13,300 adjusted figure reported for May.

Payrolls during June 1954 were: *Flat Glass:* A preliminary $10,665,131 was reported. When compared with the previous month's adjusted $10,636,973, a rise of .2 per cent is shown. *Glass and Glassware, Pressed and Blown:* Preliminary figures show payrolls during June of $23,263,435, which is 1.2 per cent below the adjusted $23,565,529 reported for May. *Glass Products Made of Purchased Glass:* A drop of 1.8 per cent during June is shown in the preliminary $3,342,768 reported when compared with the previous month's adjusted payrolls of $3,406,130.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers	July, 1954
Foods	925,000
Medicinal & Health Supplies	886,000
Chemicals, Household & Industrial	719,000
Beverages, Returnable	786,000
Beverages, Non-returnable	126,000
Beer, Returnable	230,000
Beer, Non-returnable	903,000
Liquors	581,000
Wines	275,000
Toiletries & Cosmetics	637,000
Sub-total (Narrow)	6,068,000
Wide Mouth Containers	
Foods	*2,803,000
Dairy Products	217,000
Medicinal & Health Supplies	316,000
Chemicals, Household & Industrial	129,000
Toiletries & Cosmetics	200,000
Packers' Tumblers	145,000
Sub-total (Wide)	3,810,000
Total Domestic	9,878,000
Export Shipments	227,000
TOTAL SHIPMENTS	10,105,000

* This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production July 1954	Stocks July 1954
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	3,655,000	4,605,000
	Wide Mouth	*3,633,000	*4,782,000
Dairy Products		218,000	313,000
Beverages, Returnable		793,000	1,386,000
Beverages, Non-returnable		149,000	210,000
Beer, Returnable		288,000	457,000
Beer, Non-returnable		898,000	849,000
Liquors		721,000	1,088,000
Wines		300,000	457,000
TOTAL		10,810,000	14,329,000

* This figure includes Fruit Jars and Jelly Glasses.

Glass container production, based on figures released by the Bureau of Census, dropped off during July 1954 to reach 10,810,000 gross. This is a drop of 3.6 per cent from the previous month's 11,219,000 gross. Production during July 1953 was 10,585,906, which is 2.1 per cent below this year. At the end of the first seven months of 1954, glass container production has reached a total of 74,802,616 gross. When compared with the production of 71,718,848 gross during the corresponding period of 1953, a difference of 4.2 per cent is shown.

Shipments of glass containers during July also fell off and were reported at 10,105,000 gross. When compared with June shipments of 11,162,000 gross, a drop of 9.4 per cent is indicated. During July 1953, shipments were 10,061,354 gross, which is .4 per cent below this year. Shipments of glass containers thus far this year have reached a total of 71,167,195 gross. This is .9 per cent ahead of the 70,478,567 gross shipped during the corresponding period in 1953.

Stocks on hand at the end of July 1954 were 14,329,000 gross. This is 4.5 per cent higher than the 13,708,000 gross on hand at the end of June 1954 and 34.5 per cent higher than the 10,645,666 gross on hand at the end of July 1953.

Automatic tumbler production during June 1954 continued to drop and was reported to be 4,962,647 dozens. This is 12.1 per cent below the 5,650,544 dozens produced during May. Production during June 1953 was 5,296,383 dozens. Shipments also dropped during June and were 5,398,843 dozens. Compared with the May shipments of 6,225,429 dozens, this is a drop of 13.2 per cent. Shipments during June 1953 were 4,799,045 dozens. Stocks on hand at the end of June 1954 dropped to 8,850,147 dozens, compared with the previous month's stocks of 9,296,925 dozens. At the end of June 1953, stocks were 11,088,567 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware dropped 4.8 per cent during June 1954 to reach 2,826,791 dozens. This is a drop from the previous month's sales of 2,987,257 dozens. During June 1953, sales had been 2,740,816 dozens. At the close of the 12-month period ending June 1954, sales had reached a total of 37,604,438 dozens, which is 9.9 per cent below the 41,739,707 dozens sold in the corresponding period of 1953.

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BOOK REVIEWS

German Monograph on Glass in the Chemical Laboratory, Second Edition

By F. Friedrichs

This book, produced in the careful manner of the Publishing House of Springer, assembles all pertinent specific information on glass used in the chemical laboratory. The emphasis is on standardization of types, dimensions and tests, as well as on completeness of description of standard types and parts. This description is accurate to the most minute detail.

Increasing international standardization creates interest far beyond documentation on German usages. Special items and glass-metal assemblies are deliberately excluded from the scope of this book. The author, a descendant of Ferdinand Friedrichs I, founder of the first Thuringian apparatus glass firm (1834), brings enthusiasm to a dry subject, as well as the qualifications of an active member of the same establishment now surviving in the firm of Greiner and Friedrichs that has migrated to the Western Zone (Wertheim a.m.).

Published by Springer Verlag Berlin, Goettingen, Heidelbert, 1954; 144 pages; 175 illustrations.

N. J. Kreidl

Flowers in Glass

Edited by Julia S. Berrall

This beautifully illustrated book is concerned with the many types of arrangements which make use of the flowers of different seasons and which were planned for a variety of occasions.

Leading flower arrangers were selected from different parts of the country to show varied and interesting approaches to flower arrangement. Novel and attractive ways of concealing stems, designs that feature them, the importance of foliage and the appropriate choice of plant materials are all described. Helpful suggestions on arranging a "florists dozen" and the tools and equipment necessary for arranging flowers in glass are also illustrated.

Published by The Studio Publications, Inc., New York City; 104 pages; $5.00.

BAUSCH & LOMB NAMES EXPORT MANAGER

The appointment of Sidney W. Steensma as Export Sales Manager of Bausch & Lomb Optical Company has been announced by Carl S. Hallauer, Executive Vice President. Mr. Steensma succeeds Gustave J. Husson, who retired recently after 43 years with the firm.

A University of Michigan graduate, Mr. Steensman earned a B.S. degree in Pharmaceutical Chemistry and did graduate work in Chemical Engineering. Before joining Bausch & Lomb, he was Director of Product Development at the Parker Pen Company for six years. He was also head of export operations for The Upjohn Company and in this capacity traveled abroad extensively for 13 years.

At Bausch & Lomb, Mr. Steensma will supervise the sale and distribution of optical products in branch offices in principal cities throughout the world, as well as operations at the company's eyeglass lens manufacturing plant at Rio de Janeiro.

West End Chemical Company plant at Searles Lake in the California desert operates 24 hours a day, 365 days a year.

Marks 30th year as source of highest quality soda ash for western industry

Since 1924, West End Chemical Company soda ash has been produced in the West to meet western industry's requirements. From the site of the world's largest natural brine deposits in the California desert, West End provides the most rapid and economical shipment of soda ash available to users throughout the West. Requirements of western users always take priority.

West End has kept pace with the West's rapid growth by consistently expanding its production and service facilities in anticipation of increased requirements.

Write for samples, prices and technical data.

Immediate shipment to customers throughout the West in company's own leased hopper cars . . . ready at all times.

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WEST END CHEMICAL COMPANY

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Executive offices: 608 Latham Square Building, Oakland 12, California · Plant: Westend, California

New Equipment and Supplies

HIGH TEMPERATURE REFRACTORY CEMENT

J. H. France Refractories Company, 1944 France Road, Snow Shoe, Pa., has announced full-scale manufacture and production of a new 3000°F. high-temperature cement, under the trade name of Hydracon 3000, for use in glass industry furnaces where high heats and severe furnace conditions require a refractory cement capable of actual use to 3000°F.

The manufacturer asserts verified laboratory tests show a melting point of 3200°F. giving the product a safety margin exceeding 200°F. Test results show high resistances to erosion, abrasion, slagging and spalling, with no permanent shrinkage either on "first" firing or after repeated cycles.

Hydracon 3000 is shipped dry, ready to mix, in standard 100 lb. waterproof containers. This product may be poured, cast, tamped, rammed or gunned into place and is highly recommended for maintenance patching when brickwork has been subjected to extreme heats.

AUTOMATIC NET WEIGHING MACHINE

Exact Weight Scale Company, Columbus, Ohio, has announced a new automatic net weighing machine with load discharge and counter for all types of free-flowing materials.

The net weigher is fed the free-flowing commodity by a vibratory feeder until the predetermined amount is in the weigh bucket. The bucket will not discharge its contents, however, until a pre-set time interval has elapsed. A counter unit records the number of weighments and shuts off the operation when a pre-set number of loads have been made. A push-button control panel also permits manual control when desired. Control rheostats provide infinite adjustments of both fast and slow rate of feed to weigh bucket, allowing greatest possible accuracy.

ABRASIVE CUTTER

Eisler Engineering Company, Inc., Newark 3, New Jersey, has announced its #11-TMM abrasive cutter of the wet type for cutting and slicing tungsten, molybdenum and other non-ferrous metals, as well as refractory materials and glass, particularly in long sheets.

The machine is well suited to make accurate longitudinal cuts on bars, tubes and sheets.

The work head carries the cutting wheel, 12" in diameter x 1/16" thick, operating at 1720 RPM from motor of ¼ HP. The work head slides on two bars of 1¼" diameter and is cranked over an effective distance of 42". The travel is manual by means of a hand wheel and feed screw which engages a half-nut on the work head. For quick return, the half-nut is disengaged from the feed screw, and the work head is easily moved back by means of a handle.

VACUUM COATER WITH BUILT-IN PHOTOMETER

American Instrument Company, Inc., Silver Spring, Maryland, has developed a new vacuum coater featuring a built-in optical photometer used to measure coating thickness. The photometer consists of a collimated light source and a sensitive photomultiplier detector. The detector can be placed to receive light reflected from the work or transmitted through the work.

Thicknesses are measured by recording a change in reflected or transmitted light while the coating is being applied. Space is provided for placing any type of filter in the optical path, and the detector is sensitive enough to record full-scale light reflected from plain, uncoated glass.

The vacuum system features a rapid pump-down cycling time by means of diffusion-pump by-pass valves. Standard items also include a water-cooled combination valve and baffle, complete gauging, filament-heating controls and meters, and high-voltage electrical clean-up power supply. A needle valve, bleeder valves and counter-balanced bell jar hoist mechanism complete with controls.

ULTRASONIC CLEANING

Branson Instruments, Inc., Stamford, Conn., has announced a new, heavy-duty 2 KW ultrasonic power generator, the Sonogen 2000, which speeds up cleaning and degreasing of parts made of glass, ceramics, metal, plastics, etc.

The 2000-watt output of the Sonogen generator is fed into a barium titanate transducer at 100,000 cycles per second. The transducer, immersed in the cleaning solvent, converts the radio frequency of 100,000 cycles per second into mechanical vibrations which sets up a violent agitation in the solvent, shaking the dirt and grease loose.

CATALOGS RECEIVED

Gredag Incorporated, Niagara Falls, New York, has issued a bulletin on its industrial lubricants.

Discussed in the folder are the various lubricants available and their particular applications. Tables give the machinery and equipment to be lubricated, consistency and grade of lubricant recommended.

Burrell Corporation, 223 Fifth Avenue, Pittsburgh 19, Pa., has issued Bulletin No. 310 describing high-temperature electric tube furnaces for laboratories.

Two models and seven sizes of Burrell unit-package tube furnaces are listed. The furnaces are offered laboratory technicians for use in the determination of carbons and sulfurs by combustion in ferrous and non-ferrous metals.

The bulletin gives complete data, including description of models and sizes, catalog numbers, dimensions, specifications, ordering date and prices. Separate charts list heating elements required.

Corning Glass Works, Special Appartus Section, Laboratory and Pharmaceutical Sales Department, Corning, New York, has announced publication of its Catalog CA-1, "Custom-Made Glassware by Corning".

The publication lists more than 2600 pieces of special apparatus, many of which have never before been listed formally. Detailed description of each piece includes an illustration, code number, size and price. The catalog lists modifications of some of the standard items of Pyrex brand laboratory glassware contained in Catalog LP-34.

Illinois Testing Laboratories, Chicago, Illinois, has made available Bulletin 4181 entitled "Alnor Pyrometer Accessories".

Specifications and performance data for Alnor thermocouples of every type and application are thoroughly covered. Also included are notes on thermocouple alloys, temperature-millivolt relationship curves, a comprehensive list of industrial applications, a convenient temperature conversion table, and a host of other valuable information in connection with pyrometers.

American Potash & Chemical Corporation, 3030 West Sixth Street, Los Angeles 54, California, has published a complete descriptive catalog of all its products. This marks the first time in the company's history that a comprehensive catalog of this type has been issued.

The catalog includes complete information of the properties and applications of chemical groups, such as borons, sodium, potassium, lithium and bromine. In addition, it contains information on such agricultural chemicals as insecticides, organic phosphates, miticides, fumigants, weed killers and defoliants.

Glass Fibers, Inc., Toledo, Ohio, has published a new 4-page brochure featuring Blue Flag glass fiber underground pipe wrap. The folder describes the function of the bonded mat material in reinforcing enamel coatings which are applied to underground oil and gas transmission lines to prevent corrosion.

What's News for you from Pemco

YOU CAN GET **HIGH** GLOSS AT **LOW** FIRING TEMPERATURE

and maintain resistance

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GOOD COLOR BEHAVIOR

Pemco Glass Colors excel in every factor that has a bearing on good behavior. In color matching . . . Pemco offers finest facilities. In formulation . . . Pemco will secure your favorite squeegee oil and furnish the color in that medium. In operating characteristics—Pemco Glass Colors won't penetrate screen while machine is idle. Their uniform smoothness gives them the free flowing properties necessary to prevent screen clogging.

WRITE FOR "GLASS COLORS BY PEMCO" WITH TECHNICAL SUPPLEMENT

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HOT OIL COLORS • COLD COLORS • SCREENING PASTES • STAINS
PORCELAIN ENAMEL FRITS • GLAZE FRITS • SATIN ETCH • COLORS

L-O-F APPOINTMENTS

Fenton H. Hutchison, for seven years associated with research and production operations of the Corrulux Division of Libbey-Owens-Ford Glass Company and its predecessors, has been named Assistant to the General Sales Manager, it has been announced.

Following his war service, Mr. Hutchison obtained technical groundwork in his chosen industrial field at the Plastics Industries Technical Institute. After service in the research laboratory with Corrulux, he held various supervisory assignments in the factory production departments, and for the last year has been serving as chief inspector.

Named Plant Manager of the Corrulux Division's Houston plant is Francis M. Nichols. Mr. Nichols has had extensive experience in production before joining Day and Zimmerman, having served as Plant Superintendent of the Thompson Machine Works and Production Manager of Wilkening Motor Company.

A. P. GREEN APPOINTMENTS

The A. P. Green Fire Brick Company has announced the recent appointment of Charles W. Glunk as District Sales Manager of its Richmond, Virginia, sales office. Mr. Glunk, graduate chemical engineer of Purdue University, was formerly a sales engineering supervisor at the company's home office.

Another new appointment is that of Dick Olson to District Sales Manager of the new Baton Rouge, Louisiana, sales office. He is a graduate of Carnegie Tech and has had many years of experience.

C. F. ELMORE DIES

C. F. Elmore, former Sales Manager of the Beverage Division of the Brockway Glass Company, died on July 17 following several years of ill health. Mr. Elmore was Manager of the Beverage Division from 1938 until his retirement in 1952.

Born in White Mills, Pa., Mr. Elmore attended the Scranton-Lackawanna Business College and was in the insurance business in Scranton prior to his joining Brockway Glass Company.

EXACT WEIGHT SCALE APPOINTMENT

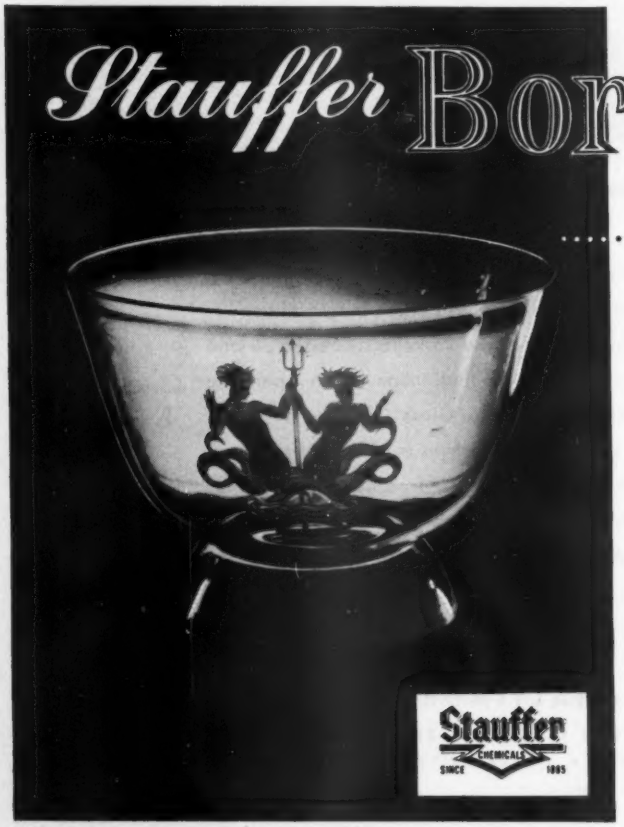
The appointment of Donald G. Marshall to the position of electronics development engineer on the engineering staff of the Exact Weight Scale Company has been announced by K. B. Neff, President.

A graduate of the University of Wisconsin, Mr. Marshall was formerly with the Erie Resistor Corporation. Much of his work in Mr. Marshall's new assignment will be concerned with development of new types of special electronic scales.

R. U. HASLANGER JOINS STAUFFER

Hans Stauffer, President of Stauffer Chemical Company, has announced the appointment of Robert U. Haslanger to the Administrative Staff.

Formerly General Manager of Sales of the Texas Division of Monsanto Chemical Company, Mr. Haslanger was more recently Director of Sales of its Plastics Division. He is a chemical engineering graduate of the University of Wisconsin.



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Technical and U. S. P.

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Borax*
Anhydrous, Pentahydrate, Decahydrate
Technical and U. S. P.

Wherever high purity borates are demanded for heat resistant, high strength and other quality glasses, Stauffer Boric Acid, Borax, and other glassmakers' chemicals—Potassium Nitrate, Sulphurs (all grades), Salt Cake (Western U. S. only)—are your guarantee of satisfaction.

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*Trade mark of West End Chemical Co., Stauffer Chemical Co., sole distributors.

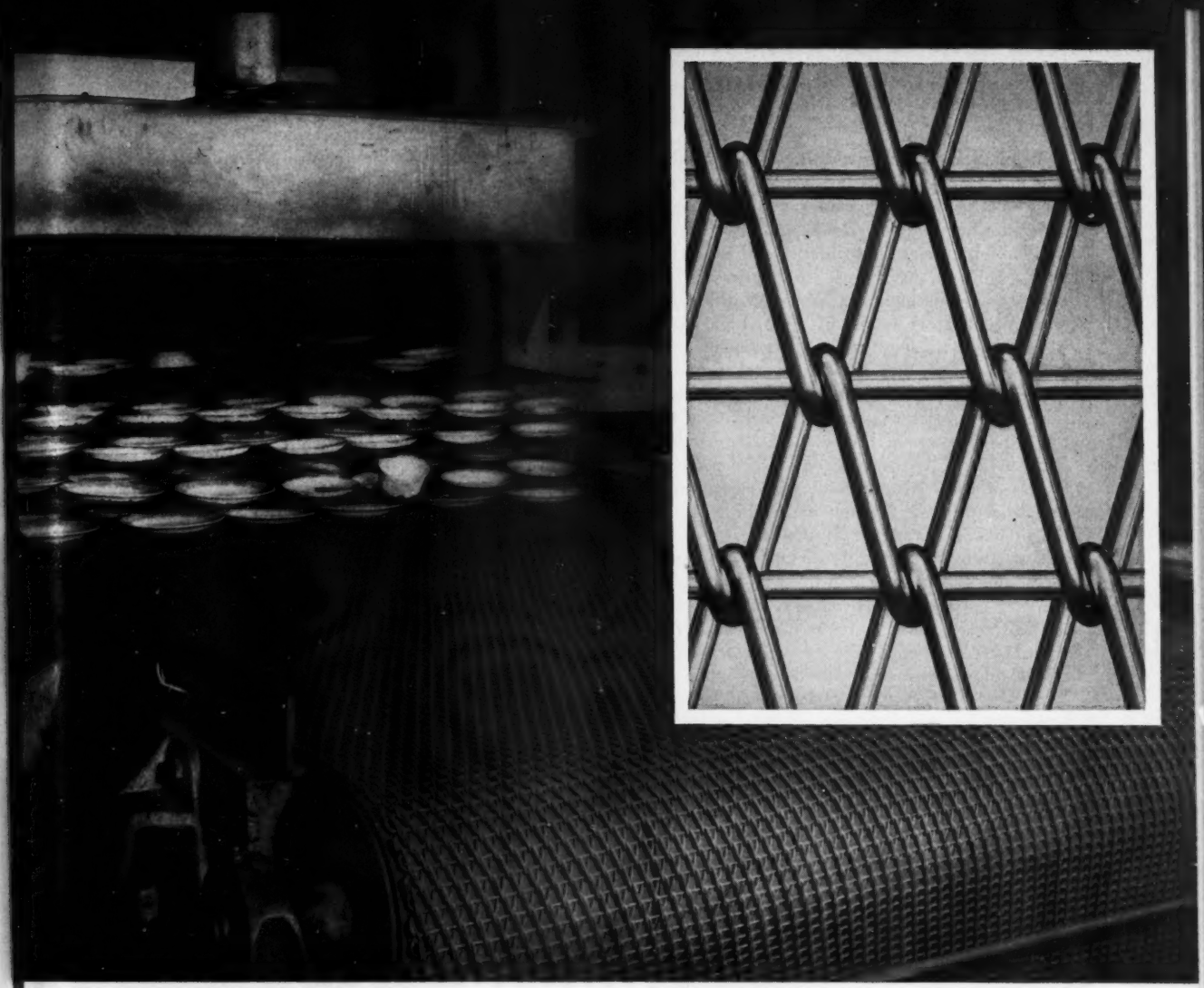


Photo courtesy of Sabin Manufacturing Co.

One WISSCO BELT *leads to another*

Efficient and dependable performance of *modernized** Wissco High-Temperature Belts inevitably leads to repeat orders.

A good case in point is the Sabin Manufacturing Co. of McKeesport, Pa., producers of dinnerware and novelty dishes. In mid-year of 1952, this company installed a Wissco High-Temperature Rod Reinforced Belt with thin spiral and dual continuous reinforcing rod for carrying ware through a lehr, in which decorations are fused to the ware. Products are in the furnace for a 3½ hour cycle at a temperature of 1260° C. The belt travels at a rate of 1 foot every four minutes and is in operation 24 hours a day, 5½ days a week.

So satisfied are company officials with the performance of this belt that recently when they were in the market for a belt on an adjacent furnace, they again specified Wissco—thus amply confirming the fact that "One Wissco Belt Leads To Another".

Why not find out what Wissco's extra durability can mean to you in longer belt life and uninterrupted production. Let us know your requirements.

***WISSCO thin spiral to resist stretch and distortion and WISSCO dual continuous reinforcing rod to prevent narrowing**

THE COLORADO FUEL AND IRON CORPORATION
Denver and Oakland
WICKWIRE SPENCER STEEL DIVISION
Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

WISSCO BELTS
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION CF&I

2324

SILK SCREEN PRINTING . . .

(*Continued from page* 486)

Ventilation is extremely important in the firing of bright gold. An oxidizing atmosphere is necessary to burn off the organic matter. A supply of fresh air along the firing level or lower section of the lehr or kiln decidedly improves the brilliance and adherence of bright gold. Modern decorating lehrs provide for vents to allow the escape of fumes. However, this does not guarantee that a fresh supply of air of high oxygen content will replace this spent air at the point of combustion or belt level. For this reason several firms have made auxiliary openings in the sides of the preheating section of their lehrs to provide for a booster shot of fresh air. This makes for cleaner and faster combustion. One firm, in order to overcome the ever present objection to loss of heat, introduces the air on the far side of the fire zone, pipes it through the fire box and distributes the preheated air in perforated piping underneath the belt at strategic points of combustion along the pre-fire zone. Results of such improvisions in decorating lehrs are very apparent in the finished product.

The time cycle of firing is dependent entirely on the ware being decorated. On thermal shock resistant glass, bright gold is successfully fired in less than ten minutes. Naturally, the faster the cycle, the higher the temperature must be raised to compensate for loss of soaking time.

• I. Wendell Hamm has been appointed Director of Manufacturing for The Carborundum Company.

THATCHER SALES APPOINTMENTS

D. R. Parfitt, Vice President in charge of Sales of Thatcher Glass Manufacturing Company, has announced several changes in the company's sales organization.

Robert G. Kenny will represent Thatcher's Container Division in the New York City area. Mr. Kenny attended Allegheny College and Temple University Graduate School. He comes to Thatcher with a background in sales and sales promotion.

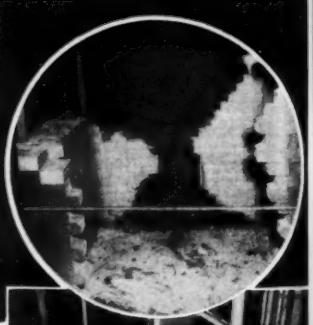
Also joining the Thatcher sales staff are Alfred C. Todd, Jr., and David R. Parfitt, Jr. Mr. Todd attended Penn Military College and Mr. Parfitt attended Cornell University. At the same time, announcement was made of the resignation of Jack Allen, Manager of Thatcher's St. Louis sales office.

DR. W. E. S. TURNER RECEIVES HONORARY DEGREE

The Honorary Degree of Doctor of Technical Science was conferred on Emeritus Professor W. E. S. Turner, F.R.S., by the University of Sheffield, England, at its Degree Congregation on July 3.

The occasion was high-lighted by the presence of many of Professor Turner's old students and friends who, after the ceremony, met in the University Staff Club to greet him and express their pleasure and good wishes. In presenting Professor Turner to the Vice Chancellor, the Public Orator, Professor Denis Brown, briefly reviewed his activities which began fifty years ago when he joined the Chemistry Department of the University.

Why Not MODERNIZE when you next shut down for REPAIRS ?



TECO

EXPERIENCE and COUNSEL will assure Top Results!

Periodic shutdown for repairs are inevitable. But manufacturers can anticipate them—contact TECO engineers and exchange views as to objectives and possibilities for modernization and basic improvements.

Then, drawing upon their vast and diversified experience, TECO engineers can develop the plans and make provisions to "move in" at the right time.

Thus, changes can be made with minimum delay and expense; and the end result will be a strictly modern plant that will run more smoothly, reduce costs and put the owners in a more favorable position to meet competition.

A consultation as to possibilities will entail no obligation.

Photos showing repair and modernization operations on a port and uptake while a temperature of 2500 degrees was maintained in the adjacent port.

TOLEDO ENGINEERING Company

GLASS MELTING and MANUFACTURING EQUIPMENT

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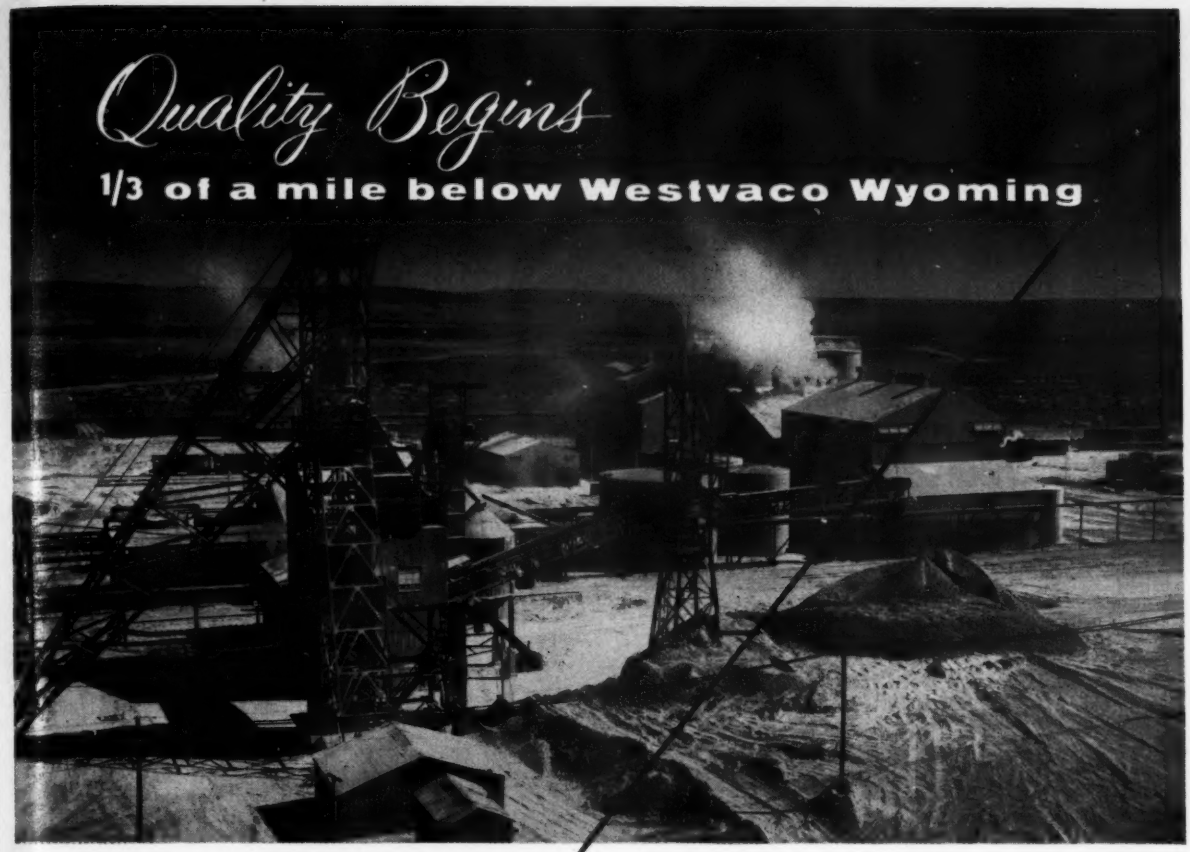
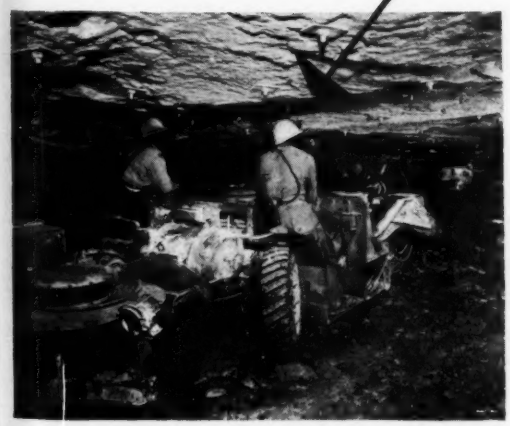
Quality Begins

1/3 of a mile below Westvaco Wyoming





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Currently, our economic shipping limits are from the Mississippi to the Panhandle to the Pacific . . . with some deviations here and there due to the peculiarities of freight rates. If you are located in this area we will be glad to furnish technical data, working samples and prices on the grade you can best use.

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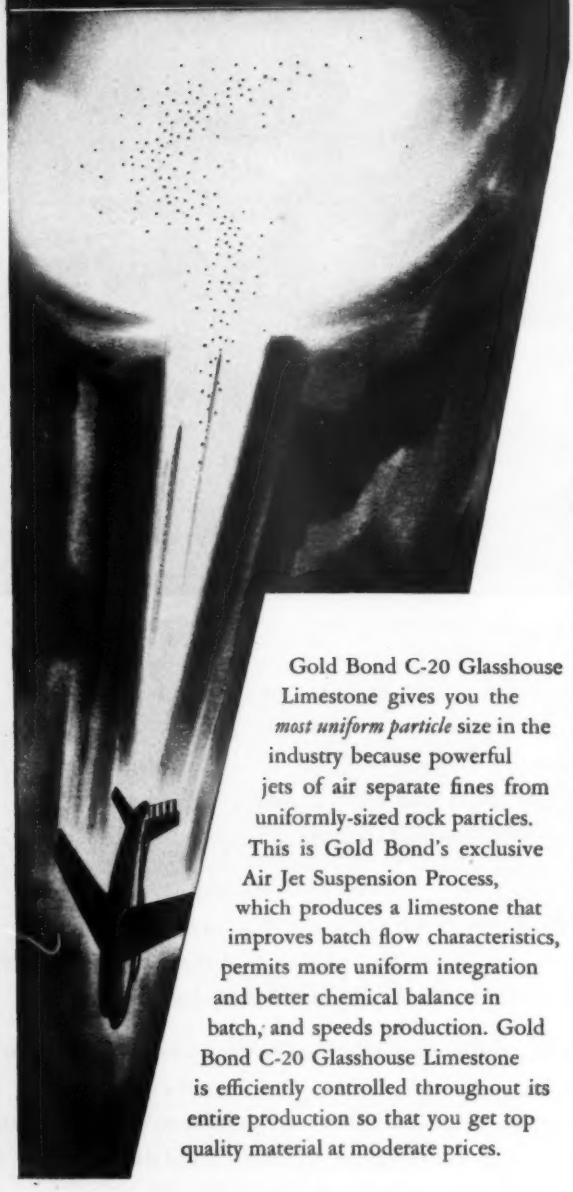
gives Glass Industry
New Uniform Limestone



Gold Bond C-20 Glasshouse Limestone gives you the *most uniform particle* size in the industry because powerful jets of air separate fines from uniformly-sized rock particles. This is Gold Bond's exclusive Air Jet Suspension Process, which produces a limestone that improves batch flow characteristics, permits more uniform integration and better chemical balance in batch, and speeds production. Gold Bond C-20 Glasshouse Limestone is efficiently controlled throughout its entire production so that you get top quality material at moderate prices.

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Gold Bond
INDUSTRIAL PRODUCTS

Ask for full information on Gold Bond C-20 and the entire line of tested lime products.

PHYSICAL PROPERTIES . . .

(*Continued from page* 484)

ing unduly alarmed. Changes beyond the most minor ones should be resorted to only when a property trend has been fully established, and then only when there are other reasons for believing the trend cannot be expected to correct itself without aid. Many times, a tank will stay permanently out of control because of overeagerness on the part of the operator to quickly bring it back to properties. Thus, when operating slightly off nominal properties, but steadily so, measures to correct should be designed to require several days to accomplish the correction. Before introducing even such mild measures, it frequently pays to re-examine the properties to determine whether the glass currently produced is indeed inferior to that regarded as nominal.

Summary

The writer has attempted to show that for most glasses quantity-produced in continuous tanks, the purposes of control are best by physical property testing rather than by chemical analysis. The criteria, by which one can choose the best properties for control, have been discussed. The relations between these criteria and the various physical properties of primary interest have been developed.

It is concluded that most glass produced in large quantity can be adequately controlled by frequent measurement of softening point and 0-300°C. expansion coefficient, followed, whenever a real property trend has been demonstrated, by appropriate action based on experience. Measurements of annealing and strain points, of flow point and density taken occasionally (perhaps every week or every month) are of value in checking on the adequacy of the control system. High temperature viscosity, run at even longer intervals, serves to round out the record. In glasses employed for glass-glass or glass-metal sealing, the expansion curve should be determined occasionally.

It sometimes becomes necessary to adopt other properties, such as electric or optical, as primary controls. Since this necessity usually arises from the requirements of the customer which are irrelevant to the glassmaker, it is well to insure that the latter's requirements are met by carrying out occasional softening point and expansion tests.

It has been emphasized that the purpose of control tests is to furnish precise and frequent information from which property trends can be recognized. Accordingly, the precision of test should be better than the specified tolerances imply. With adequate test precision, batch or operational changes can always be predicated on an established trend and can be designed to promote a slow return trend, thus minimizing the risk of a major upset

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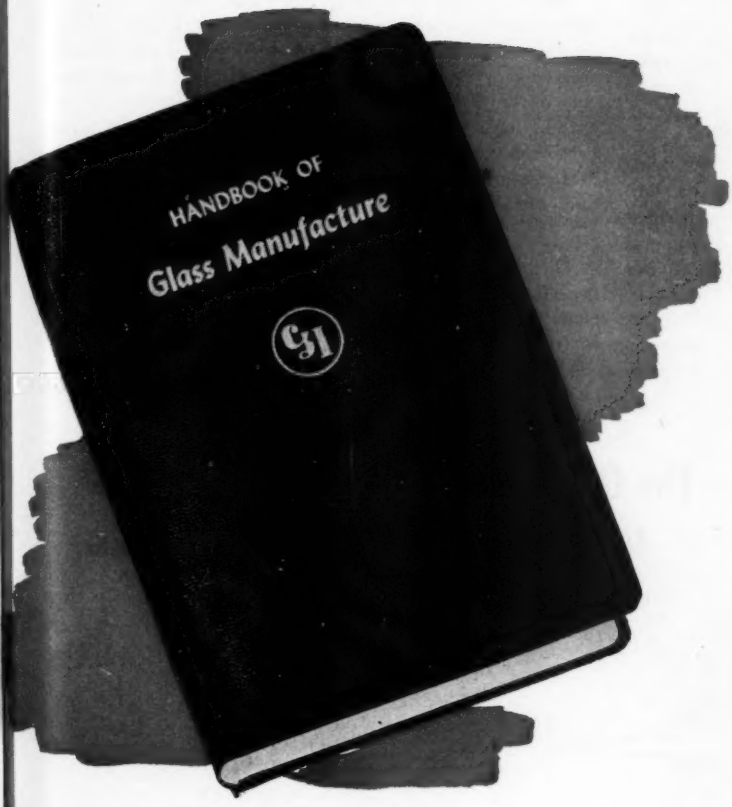
3. H. R. Lillie. J. Amer. Ceram. Soc., *35*, p. 149 (1952).
4. J. T. Littleton. J. Amer. Ceram. Soc., *10*, p. 259 (1927). J. Soc. Gl. Tech., *24*, p. 176 (1940).
5. Specification recently adopted as tentative standard procedure by A. S. T. M. Committee C-14.
6. Three standard glasses (a lead, a lime, and a borosilicate glass) have been recently set aside by the Glass Division of the American Ceramic Society. Details can be obtained from Mr. Francis Glaze, National Bureau of Standards, or Prof. S. R. Scholes, Sr., Alfred, New York.
7. J. T. Littleton. J. Opt. Soc. Amer., *4*, p. 224 (1920). H. R. Lillie. J. Amer. Ceram. Soc., *14*, p. 502 (1931), *37*, p. 111 (1954).

It's *new*

and it's *different*



IT'S NEW because twelve years have passed since the first handbook for glass manufacturers was published and so much has taken place in the intervening years in technological and engineering development.

IT'S DIFFERENT because it is the only single volume where so much pertaining to all phases of glass manufacture will be found.

The NEW ***Handbook of Glass Manufacture*** is comprised of more than 500 pages of practical reference data . . . tables, charts, formulae, illustrations, and text. It is a primary working tool for plant executives, research heads, laboratory technicians, and engineers. It is a reference book that should be immediately available when you have a question or need a quick start to the solution of a problem. It is edited for glassmen by those who know glass.

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GJ

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REFRACTORIES DESIGN . . .

(*Continued from page* 485)

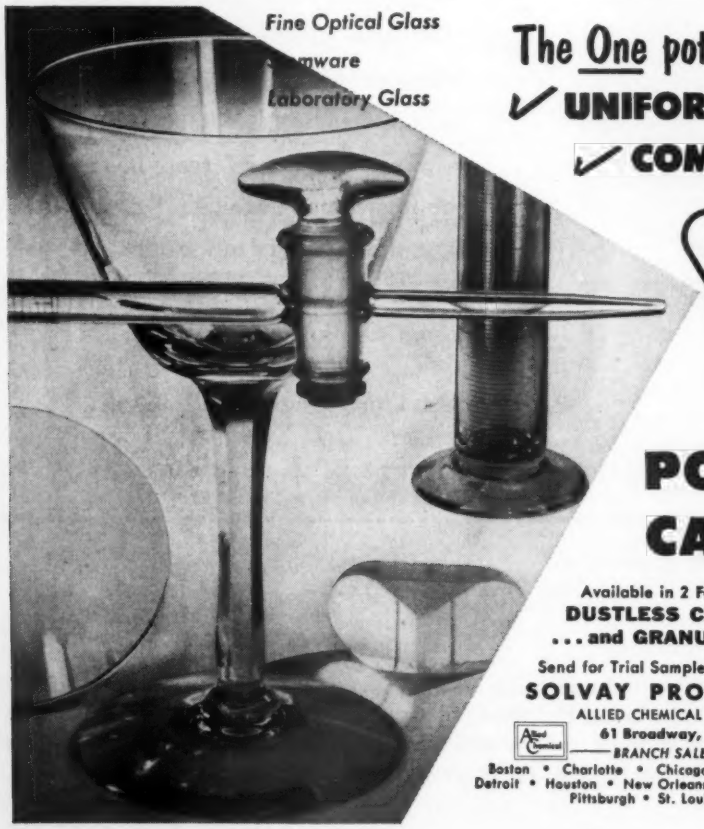
This also will result in a tight joint which glass cannot enter. Therefore, in the building of refining end bottoms and sidewalls, I recommend a 100% clay construction.

The melting end bottom of a glass melting furnace is probably the most interesting to the block manufacturers as differentiating from brick manufacturers. The reason for this, of course, is that the melting end bottom has the greatest tonnage of any portion of a furnace. Traditionally these bottoms have been built of clay type blocks. However, in recent years, the sidewalls have been beefed up to give longer service and it was necessary to do likewise to the bottom. To overcome this, the clay manufacturers have recently introduced to the market a premium type clay block primarily used in the bottom of a glass melting furnace. This block will extend the life of the bottom 20 to 30 per cent. This block is different from the standard in that it has a higher alumina content, a lower porosity and a p.c. equivalent of 33. Prior to 1930, most of the clay blocks were made by the hand rammed process. However, in that year, Findlay Clay Products Company patented and introduced the Findlay Vacuum Cast Tank Block. Since the original patent was issued, much work has been done to improve this block and many advances have been made. By carefully steadying the grain size, we have reduced the porosity of the block. By careful selection of clays, we have decreased the impurities in the block. These improved burning methods have resulted in a block of approximately 16% porosity, less than 1% iron, a p.c. equivilent of 31.

In a recent survey conducted by a research foundation, it was determined that fuel was probably the highest single cost in melting glass. It is, therefore, indicated that clay blocks are the most economical for use in melting glass due to their insulating characteristics. Another costly item in building a glass furnace is the setting of the blocks. We at Findlay recognized this several years ago, designed and had built for us a special grinding machine that grinds two sides of a block at one time. This machine grinds opposite sides of the block parallel, and adjacent sides at right angles. Recently we have had several glassmen advise us that they have laid an entire bottom without the necessity of chipping a single block. This, of course, is a considerable labor and time saver for the glassmen.

We know that the aim of every glassman is to pack as many pieces of ware with the least possible cost and we in the refractories industry are trying to do all possible to give you the best block we can to aid you in your aims. As you know by now, this discussion has been very general in nature and I have not attempted to put a lot of figures in that would only be confusing. I only ask that you in the glass industry give the clay block manufacturers due consideration when you are designing your furnaces.

• The Industrial Furnace Manufacturers Association, Inc., has changed its name to Industrial Heating Equipment Association, Inc., according to Carl L. Ipsen, Executive Vice President. Membership has also been broadened to include induction and dielectric heating equipment, ovens and combustion equipment.



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. . . and GRANULAR Hydrated is 83-85% K_2CO_3

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Other Solvay Products for the Glass Industry:
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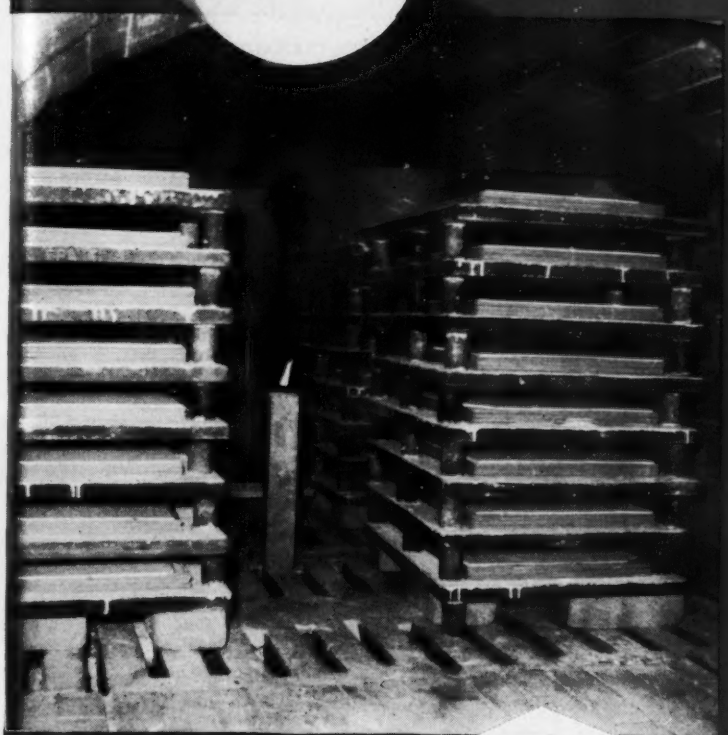
How ALCOA ALUMINA improves firing results for FILTROS, INC.



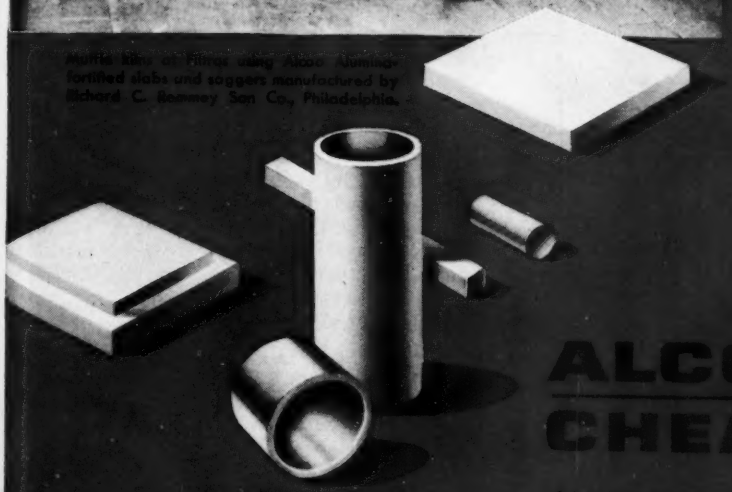
Mantle kiln at Filtros using Alcoa Alumina-fortified slabs and saggers manufactured by Richard C. Remmey Son Co., Philadelphia.

For more than five years, Filtros, Inc., East Rochester, N. Y., has used ALCOA Alumina as a basic raw material in the manufacture of electrolytic diaphragms. They've found that ALCOA Alumina prevents "moving" in firing, reduces shrinkage to a minimum. Moreover, the plates do not crack even with moderate jumps in the firing cycle. ALCOA Alumina further assures the low electrical resistance required from an electrolytic diaphragm.

ALCOA Alumina is also used to fortify the slabs and saggers used in firing at Filtros. Alumina-fortified slabs last longer than ordinary slabs . . . increase load-bearing strength . . . reduce costs.

This is typical of how ALCOA Aluminas are used to improve products and reduce manufacturing costs. These versatile aluminum oxides enable *refractories* to withstand higher temperatures and last longer . . . improve the dielectric strength of *insulators* . . . increase thermal and mechanical shock resistance in *glass and ceramic products.*

For complete details and experimental samples, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 713-J Alcoa Building, Pittsburgh 19, Pa.



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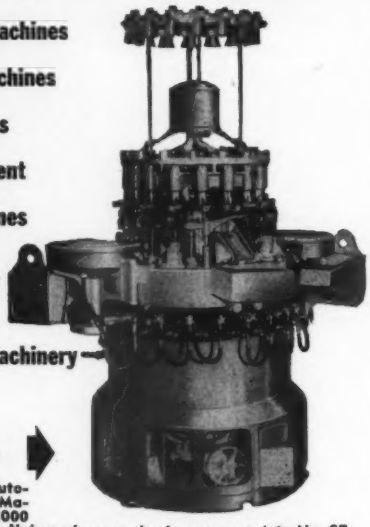
★ Exhaust Equipment
★ Finishing Machines
★ Glass Lathes
★ Stem Machines
★ Special Glass Machinery



Illustrated at right—Automatic Hot Cut Flare Machine with capacity of 3000 to 4000 pieces per hour. Universal upper chucks accommodate No. 27 to No. 44 tubing. Micrometer adjustments for cutter and flaring tool.

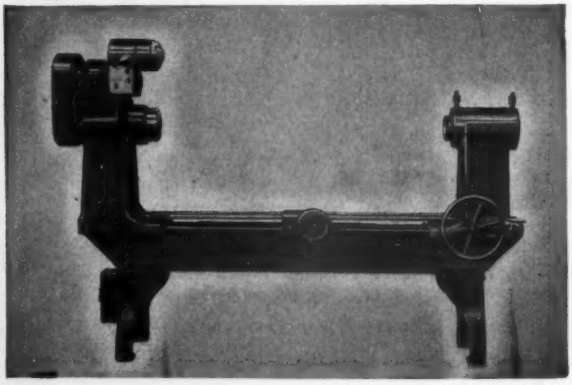
● Standard Tool engineers are specialists in the design and manufacture of automatic machines for all types of incandescent lamps, fluorescent, electronic and cathode ray tubes. Over 40 years experience in the glass field, plus precision manufacturing refinements assure you of equipment that will exceed your production expectations. A competent engineering staff is available for consultation at your convenience. Standard Tool machines have been production-proven over many years!

Creative Machine Designers & Builders

STANDARD TOOL & MANUFACTURING CO.

235 LAUREL AVENUE
ARLINGTON, NEW JERSEY

Illustrated below—5" Spindle Glass Lathe designed for television tube production —— 75" maximum distance spindle to spindle and 44" diameter swing. Has high ratio spindle length to spindle diameter and tapered spindle bearings. Incorporates hand scraped ways and integral variable speed drive.



LENSES — 300 B.C. . . .

(*Continued from page* 491)

of their earliest exports.

Due to the size and shape of the lenses that have come down to us from 2300 years ago, it has been suggested that they might have been used as spectacles. This would have been an interesting discovery indeed, for the earliest known use of spectacles was in Europe and China during the 13th century. In the absence of any supporting evidence, however, it must be considered more likely that these ancient lenses were used as hand glasses, probably as an aid to engraving gems. How far back in history the use of simple lenses for magnification extends has never been established. These lenses, removed from the tombs of ancient Carthaginians, may be the oldest lenses in the world today.

FRANCE REFRACTORIES COMPANY NAMED LICENSEE

J. H. France Refractories Company has been named Northeastern United States and Canadian licensee for the manufacture of the Walters Loktite Checker system for glass industry checkerwork application, according to a joint announcement by H. W. Walters, checker system designer, and W. A. France, President of the company.

France Refractories Company will manufacture the Walters Loktite Checker system for shipment throughout Northeastern United States and Canada. The checker will be manufactured of France's Lehigh brand, vacuum pressed, low porosity checker material.

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NEW TRANSLUCENT FIBER GLASS MATERIAL AVAILABLE

A new, translucent fiber glass building panel is being introduced by Plastics Division of the Strick Company. The fiber glass sheets are made in both corrugated and flat types under the trade name, "Daycor".

Daycor is perfectly suited for "do-it-yourself" projects because it is easily installed with ordinary tools. It can be sawed, nailed, screwed or drilled just like wood, yet cannot warp or rot and never needs painting. Daycor is currently being produced in ten brilliant colors, as well as black. In producing the material, a fiber glass mat is bonded in a polyester resin. The resulting sheets are shatterproof, strong, light and transmit light.

WYANDOTTE APPOINTMENTS

Charles F. Sanborn, Manager of Wyandotte Chemical Corporation's Michigan Alkali Division Market Research Department, has been promoted to Senior Sales Representative in the company's Eastern District Office. He will have his headquarters in New York City.

A Phi Beta Kappa graduate of Duke University, Mr. Sanborn has been with Wyandotte for 13 years, nine of them doing market research. He has been department manager since 1951.

Named to succeed Mr. Sanborn is Dr. Robert I. Chien. In his new position, Dr. Chien will be responsible for market research and forecasting for divisional products. Het has been a member of the department since September 1951. A graduate of the University of Minnesota, Dr. Chien received his Ph.D. in 1953.

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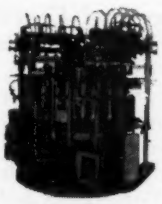

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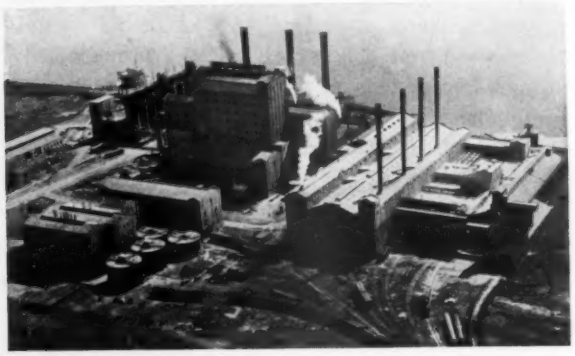
Milestones in Glass Progress

PHOTO COURTESY TOLEDO MUSEUM OF ART

1651 The principal German drinking vessel in the 17th century was the cylindrical tankard—usually of large dimensions, such as this glass Humpen. Scenes on Humpens, in opaque enamel, depicted everything from coats-of-arms and churches to playing cards. This Humpen, dated 1651, commemorates the Peace of Westphalia.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (North Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte
CHEMICALS

Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

RESEARCH DIGEST . . .

(*Continued from page* 501)

ating efficiency. A comparison of one furnace with another as a structure is obviously only justified when optimum operating conditions are attained in each.

With respect to the influence of glass composition on Q values, it is admitted that in our present state of knowledge, a direct comparison between two furnaces is possible only when similar glass is made in each and corrections have still to be determined for different glass compositions.

Of two tanks, the one with the higher Q value must be less efficient thermally, assuming that the operating conditions are the best possible for each, and the accuracy of this statement is unaltered by the fact that the lower efficiency may be imposed as the result of manufacturing requirements.

NEW DECORATIVE GLASS

A new decorative glass, combining two popular decorating features, corrugation and a light-diffusing patterned surface, is now being manufactured by the Blue Ridge Glass Corporation. The glass is sold through Libbey-Owens-Ford Glass Company, exclusive sales agent for Blue Ridge patterned glass products.

According to the announcement, the new glass is ⅜" thick, with corrugations 2½" center to center. The Muralex pattern, which is rolled onto the surface of the glass as it is made, has a textured, neutral tone which blends with any decorating scheme.

CORNING APPOINTMENT

The appointment of Amory Houghton, Jr. as Manager of appliance parts sales at Corning Glass Works has been announced by Russell Brittingham, Vice President and General Manager of the company's Technical Products Division. Mr. Houghton will direct the sale of glass components to manufacturers of kitchen ranges, washers, refrigerators, food mixers and similar appliances.

Associated with Corning since 1951, Mr. Houghton first served in the accounting department of the Central Falls plant. He later became junior process engineer at the Fall Brook plant.

O. HOMMEL NAMES DISTRICT MANAGER

Ernest M. Hommel, President of The O. Hommel Company, has announced the appointment of Everett H. Shands as Midwest District Manager of porcelain enamel frit sales and service, with headquarters in Chicago.

Mr. Shands, who holds a B.S. degree in ceramic engineering and a Masters Degree in mechanical engineering, has been associated with the ceramic industry for the past 22 years. He was formerly connected with Detroit Vapor Stove Company, Norge Corporation and the George D. Roper Corporation.

• The Ninth Annual Meeting of the Pennsylvania Ceramics Association was recently held at Pennsylvania State College. The three-day schedule included a Board of Directors meeting, two half-day technical sessions, a general business meeting, open house of ceramic research laboratories, and special recreation and entertainment programs.

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PRODUCTION ASSISTANT, glass molding and specialty fabricating plant. Must have mechanical background, actual experience supervising production department; capable of organizing, training, supervision personnel. Permanent position with growing company. If qualified, write full particulars, age, experience and salary desired to Box 158, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

OWENS CORNING APPOINTMENT

The appointment of Frederick Kiel, Jr. as Assistant Treasurer of Owens-Corning Fiberglas Corporation has been announced by Harold Boeschenstein, President.

Mr. Kiel will continue to serve as Credit Manager, a post he has held since 1950. He joined the company in 1941, organized its Pricing Division and was Pricing Division Manager from 1946 to 1950. Mr. Kiel attended Wayne University and prior to joining the Fiberglas organization was associated successively with the Union Guardian Trust Company and Firestone Tire & Rubber Company.

• C. R. Fay, Comptroller of Pittsburgh Plate Glass Company, has been elected President of the Controllers Institute of America, effective September 1. He will suceed George W. Schwarz, Vice President and Treasurer, Wyandotte Chemicals Corporation, who has been chosen Chairman of the Institute's Board of Directors.

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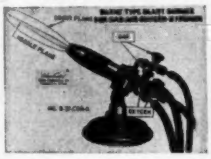
BLAST BURNERS



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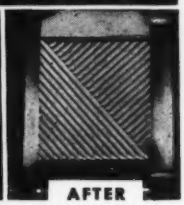

Complicated molds are easily cleaned and left *ready for use* with Pangborn Hydro-Finish! Hand cleaning and polishing is virtually eliminated! And you save additional time and labor because a Hydro-Finish machine, operated by one man, removes discoloration and scale in *minutes* instead of hours!

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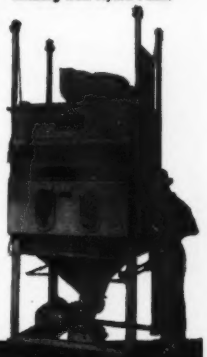
Get complete facts on Hydro-Finish and how it can save *you* money! Write for Bulletin 1400-A to: PANGBORN CORP., 3400 Pangborn Blvd., Hagerstown, Md.

Actual untouched photos of mold before and after cleaning with Hydro-Finish



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INDEX TO ADVERTISERS

	Page
Aluminum Company of America	515
American Potash & Chemical Corp.	477
Calumite Company, The	520
Carborundum Company, The	473
Classified Advertising	519
Corhart Refractories Company	465
Diamond Alkali Company	478
Drakenfeld & Co., Inc., B. F.	475
du Pont de Nemours & Co., Inc., E. I.	471
Eisler Engineering Company	519
Exact Weight Scale Company	517
Forter-Teichmann Company	519
Frazier-Simplex, Inc.	463
Harshaw Chemical Company, The	469
Kahle Engineering Company	517
Kaiser Aluminum and Chemical Company	467
Kirk & Blum Manufacturing Company	Cover II
Laclede-Christy Company	480
Lynch Corporation	466
Morgan Construction Company	468
Mullite Refractories Company	504
National Gypsum Company	512
Ottawa Silica Company	516
Overmyer Mould Company	476
Pacific Coast Borax Company	470
Palmer & Associates, Delos M.	519
Pangborn Corp.	519
Pemco Corporation	507
Sharp-Schurtz Company	519
Solvay Process Div., Allied Chemical & Dye Corp.	514
Standard Tool & Mfg. Company	516
Stauffer Chemical Company	508
Surface Combustion Corp.	Cover IV
Taylor Sons Company, Chas.	Cover III
Toledo Engineering Company	510
Vitro Manufacturing Company	479
Walsh Refractories Corp.	474
West End Chemical Company	505
Westvaco Chemical Div., Food Machinery & Chemical Corp.	511
White Dental Mfg. Co., S.S., Industrial Div.	472
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.	509
Wyandotte Chemicals Corp.	518